

A LONG TERM VISION FOR
THE SACRAMENTO-SAN JOAQUIN DELTA:

A Work in Progress

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Delta Vision Blue Ribbon Task Force

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There is a growing understanding that beneficial uses of the Sacramento-San Joaquin Delta as a unique ecosystem, a major agricultural area, a significant source of water supply for the San Joaquin Valley and Southern California, and a site for human occupancy are not sustainable. This understanding is fueled in large part by emerging concerns regarding seismic risk to levees and the regional effects of global warming. However, even absent these emerging concerns, current trends in the Delta from increasing water diversion, urban development, and other causes are leading to the collapse of the Delta ecosystem and degradation of water quality and supply.

It is not too late to protect the Delta's beneficial uses. In the wake of Hurricane Katrina and the collapse of delta smelt and other fish populations in the Delta, the attention of decision makers, stakeholders, and the public is focused on the need to change business as usual in the Delta and adopt policies that anticipate future challenges. This document presents an overview of a long-term vision for the Delta that would help ensure its viability over the next century and beyond. In this vision, the Delta's ecosystem would be improved through numerous restoration and management actions that would also help improve flood management and water quality, while not diminishing the viability of the agricultural industry in the Delta. The improvements would also enhance recreational tourism opportunities. The vision includes the following essential components:

- A mosaic of habitats and habitat corridors throughout the Delta to offset historic and future habitat loss.
- Subsidence management and reversal on central and western Delta islands to reduce the risk and effects of levee failure.
- Flood bypasses and floodplain corridors to reduce risk of island failure and create habitat benefits.
- More natural flow conditions, including likely reduced total diversions in and upstream of the Delta, to provide adequate habitat for flow-dependent native species and communities.
- Reliable alternative water supplies for communities that currently export Delta water.
- Actions to eliminate water quality degradation from in-Delta and upstream sources.
- Near-term actions to protect public safety and prevent species extinctions.
- A phased, experimental approach to evaluate alternative Delta conveyance options on the basis of reversibility and ecological compatibility, focused on the least intrusive and more reversible actions first.
- New institutional arrangements for managing the Delta.
- A realistic, "beneficiary pays" financing plan to implement the Delta Vision plan.

A Mosaic of Habitats and Habitat Corridors Throughout the Delta

The Delta was historically a vast freshwater tidal wetland interspersed with riparian woodlands and seasonal ponds, supporting hundreds of endemic plant and animal species. Over the last 150 years, more than 90% of the Delta's original natural habitat has been lost to diking and channelization. Over the next century, rising sea levels, increased flood risk, subsided island elevations, aging and under-engineered levees, urbanization at the Delta's margins, and potential seismic events could destroy the Delta's remaining patches of habitat.

The Delta is not a homogenous landscape. Soil types, island elevations, and other factors vary significantly not only between different parts of the Delta but between different parts of individual Delta islands. A successful approach to restoring Delta habitat will exploit this significant variation to re-establish a diversity of habitat types throughout the Delta.

Primary areas for restoring tidal wetlands and associated habitats include:

- Suisun Marsh.
- McCormack Williamson Tract.
- Decker Island and adjacent islands.
- Three Mile and Seven Mile Sloughs.
- Dutch Slough.
- The southern shoreline of Suisun Bay.
- The western bank of the lower Sacramento River.
- Flooded islands such as Big Break and Franks Tract.

Habitat corridors allow for the movement of nutrients and organisms between different habitat areas and provide a range of habitat types, along an environmental gradient of salinity, turbidity, water circulation, vegetation, and other factors that meet the varying needs of different species at different life-history stages. Primary areas for establishing habitat corridors include:

- The lower Cosumnes and Mokelumne Rivers.
- Yolo Bypass and Cache Slough.
- Stone Lakes and Snodgrass Slough.
- Elk Slough.
- The lower San Joaquin River, including an Old River corridor.
- A South Delta flood bypass on Middle River.

See Attachment 1 for a preliminary set of recommendations for creating potential habitat areas and habitat corridors.

Subsidence Management and Reversal on Central and Western Delta Islands to Reduce the Risk and Effects of Levee Failure

Subsidence is most advanced in the central Delta islands, composed largely of organic peat soils, and in the western Delta islands, which are more heterogeneous in soil profile but also more subject to seismic risk from Bay Area faults. The potential for saltwater intrusion is highest from failure of these central and western Delta island levees.

There is no single solution to the problem of subsided island elevations in the Delta. Rather, a mix of strategies should be used to reduce the risk of island failure. Primary approaches include:

- Managing wetlands for accelerated tule growth on Sherman, Twitchell, Jersey, and other islands.
- Using dredged and borrow materials to rebuild Sherman, Twitchell, and other islands and strengthen levees.
- Partitioning Sherman, Jersey, Bradford, and other islands with cross levees.
- Intentional flooding of islands at high risk of failure under controlled conditions.

See Attachment 1 for a preliminary set of recommendations for potential subsidence management reversal projects.

Flood Bypasses and Floodplain Corridors to Reduce Risk of Island Failure and Create Habitat Benefits

Historically, the Central Valley's vast natural flood basins and riverine floodplains were regularly inundated during the winter flood and spring snowmelt seasons, regulating inflows to the Delta and San Francisco Bay and providing highly productive seasonal habitats for food production, fish spawning and rearing. Recreating flood basins and reconnecting floodplains to rivers would significantly attenuate flood flows into the Delta, which are expected to increase in intensity as a result of global warming, and create habitat refugia upstream of current Delta habitat locations.

Primary areas for creating flood bypasses and floodplain corridors include:

- Modifying the Fremont Weir to allow increased inundation of the Yolo Bypass, much of which is publicly owned.
- Constructing a new South Delta Bypass and Floodway on Stewart Tract.

See Attachment 1 for a preliminary set of recommendations for creating flood bypasses and floodplain corridors.

More Natural Flow Conditions, Including Likely Reduced Total Diversions in and Upstream of the Delta, to Provide Adequate Habitat for Flow-Dependent Native Species and Communities

Freshwater inflows to and outflows from the Delta are among the most important drivers of ecological conditions in the Bay-Delta estuary. Flows transport aquatic organisms and nutrients, improve water quality, trigger seasonal movements and reproduction, and provide the low salinity habitat upon which many Delta species depend. The abundance and distribution of many Delta species are strongly correlated to freshwater flow conditions.

Over the last two decades, water storage and diversions upstream of the Delta, combined with direct exports from the Delta, have on average reduced spring outflows to San Francisco Bay by over 50% and annual outflows by almost 50%, shifted low salinity habitat many kilometers upstream, and created large-scale reverse flows in Old and Middle Rivers for over half the year. In recent years, increasing diversion and export levels have created habitat conditions similar to those of the most severe droughts of the 20th century. The recent collapse of Delta pelagic fish populations is strongly linked to the recent changes in the timing and magnitude of exports. Reductions in inflows and outflows have also significantly reduced natural salinity fluctuation, which may encourage exotic species invasions and changes in the Delta food web.

Primary approaches to simulate more natural flow conditions and provide adequate habitat conditions for flow-dependent Delta species include:

- Increasing inflows to the Delta from the Sacramento River during the summer and fall and from the San Joaquin River during all months.
- Inundating the Yolo Bypass more frequently.
- Increasing Delta outflows in spring and fall except in the driest years.
- Eliminating reverse flows in the spring and reducing reverse flows during the rest of the year in Old and Middle Rivers.

See Attachment 2 for a preliminary set of recommendations for securing more natural flow conditions.

Reliable Alternative Water Supplies for Communities that Currently Export Water from the Delta

The Delta is neither the only nor the most significant source of water supply for many export water users. Nonetheless, disruption of Delta water supplies because of extended drought, environmental crises, degraded water quality or other causes is a major issue for water suppliers seeking greater reliability. There are two compelling reasons to adopt a policy of reducing export user reliance on the Delta. First, exports have had a devastating effect on the health of Delta fish populations and on Delta habitat conditions. Second, the emerging risks of global warming and catastrophic levee failure render Delta supplies increasingly vulnerable to further disruption.

A central requirement of a long-term Delta vision should be a state commitment to reduce reliance on Delta exports to protect the Delta ecosystem and reduce water user vulnerability. Fortunately, there are many options available to Delta exporters to secure alternative supplies and manage demand, which could reduce total urban and agricultural water use by 20% or more from current levels. Primary actions to achieve significant export reductions include:

- Improving incentives for urban water conservation, including rebates and rate structures that encourage efficiency and eliminate subsidies.
- Adopting mandatory requirements for water-efficient urban landscaping.
- Increasing funding and support for agricultural water conservation and recycling projects.
- Investing in groundwater treatment for small communities and other areas that rely on groundwater for drinking water supplies.
- Promoting environmentally sound conjunctive management, reservoir re-operation, and groundwater banking programs.
- Facilitating environmentally sound exchanges and transfers to Delta export regions from non-export areas.
- Exploring the potential for savings from stormwater management and oil-water reclamation.
- Retiring 200,000 – 300,000 acres of drainage-impacted lands in the western San Joaquin Valley.

See Attachment 3 for a preliminary set of recommendations to reduce reliance on Delta exports.

Actions to Eliminate Water Quality Degradation from In-Delta and Upstream Sources

Agricultural and urban runoff and subsurface drainage from Delta islands and from the Central Valley watershed contain pesticides, fertilizers, legacy contaminants, and trace elements and salts leached from the soil by irrigation. These pollutants degrade the many beneficial uses of Delta water, including the quality of drinking water for urban areas, the productivity of agricultural land, and the health of the Delta ecosystem. Of particular concern is the rising threat of contaminants in runoff to public health, both for Delta residents and the many communities that depend on the Delta for drinking water, recreation, and subsistence food supply. Toxic effects have also been identified as a potential contributor to the decline in Delta fish populations.

Unfortunately, the water quality data necessary to accurately assess the type and toxicity of contaminants in Delta waters is lacking. Improved and expanded monitoring programs are essential to safeguard public health, develop a baseline for ecosystem conditions, and track changes in the amount and types of pollutants entering the Delta, including those not currently regulated by the state and federal governments.

Primary actions to reduce the amount and toxicity of agricultural drainage, wastewater discharges, urban runoff, and other pollutant sources in Delta inflow include:

- Revising or eliminating the Central Valley agricultural discharge waiver program, which has failed to aggressively identify and reduce contaminant loading. In addition, the state should require expanded monitoring of drainage and drains, and implementation of best management practices to reduce discharge toxicity and volume.
- Prohibiting agricultural subsurface drainage discharge to the San Joaquin River.
- Retiring at least 200,000 – 300,000 acres of severely drainage-impaired lands in the western San Joaquin Valley.
- Reducing urban runoff through increased funding and implementation of stormwater capture programs and stormwater management projects.
- Updating and installing improved wastewater treatment facilities to reduce untreated contaminants in wastewater discharge.
- Implementing mine remediation programs and in-basin control measures to reduce mercury and other legacy contaminants in the Delta.
- Funding and implementing a more comprehensive water quality monitoring program for the Delta.

Near-term Actions to Protect Public Safety and Prevent Species Extinctions

Evaluation, adoption, and implementation of the components of a sustainable and durable long-term vision for the Delta will take many years. In the interim, it is critical that the most sensitive uses of the Delta – the lives of those people who currently reside in the Delta and the continued existence of those endemic native species which rely on the Delta – be protected through a set of actions which do not require years of preparation and which are effective in preventing tragic loss of lives and species. Primary near-term actions include:

- Developing Delta-wide emergency plans, which also consider ecosystem impacts of emergency actions.
- Developing a comprehensive flood plan for the Delta, with an emphasis on protecting existing urban areas, using floodways, and integrating flood management measures with efforts to restore non-tidal and tidal wetland habitat. This document includes many specific tools that should be incorporated into such a plan.
- Providing adequate funding to bring flood management for existing urban areas up to at least a 200 year level of protection.
- Prohibiting new urban developments outside of existing settlements on deep floodplains and along floodway corridors.
- Modifying Central Valley Project and State Water Project export operations to avoid high incidental take levels and increase the amount of water available for environmental uses.
- Acquiring areas for potential habitat restoration that are at high risk of urbanization.
- Installing or removing barriers and other flow control structures that improve ecosystem conditions for endangered species.

A Phased, Experimental Approach to Evaluate Alternative Delta Conveyance Options on the Basis of Reversibility and Ecological Compatibility, Focused on the Least Intrusive and More Reversible Actions First

Major changes to how the Delta is managed are necessary to protect its beneficial uses. These changes may include modification of the current physical system for conveying water through the Delta to the SWP and CVP pumps. Any potential changes to the conveyance system should be evaluated using a phased, experimental approach that includes the following criteria:

- The ability to meet specific performance targets for ecosystem protection and restoration, export reduction and other desired Delta conditions.
- Compatibility with the vision for habitats and habitat corridors, more natural flows, and other core elements of a long-term plan for the Delta.
- Testing the least intrusive and more reversible actions first, and considering more intrusive and less reversible actions based on whether performance targets are being met.

New Institutional Arrangements for Managing the Delta

The Delta suffers from a combination of piecemeal public policies implemented without coordination by a patchwork of public agencies and private interests. These policies prevent managing the Delta as an integrated ecosystem and human landscape and promote public subsidies that incentivize increased urbanization and water diversion rather than sustainable use. A long-term, integrated approach to governance for the Delta should include the following elements:

- Recognizing the special status of the Delta in governance, and improving governance mechanisms for controlling urbanization, flood management, water operations and habitat restoration.
- Reforming the State Water Project and improving oversight of all water project operations.
- Creating a private enforcement agreement to better control Delta water management.
- Requiring a fair share of Delta flow from upstream and in-Delta water users.
- Developing a financing plan based on the “beneficiary pays” principle.
- Eliminating public subsidies for Endangered Species Act compliance.
- Directing state water supply investments to projects that reduce reliance on Delta exports.
- Creating a system of export user fees to support implementation of a long-term Delta vision.

See Attachment 4 for a preliminary set of recommendations to implement new institutional arrangements for the Delta.

A LONG-TERM VISION FOR THE DELTA

Attachment 1: Habitats and Habitat Corridors

The habitat restoration, flood corridor, levee construction, and highway modification projects described below and depicted on maps 1-6 were developed based on an analysis of topographic and soil maps, aerial photographs, and numerous field trips. Tidal marsh restoration zones were sited where land elevations are at or near sea level or could be elevated to suitable elevations with nearby fill material. New floodway corridors were located in relatively undeveloped areas where it seemed possible to divert water out of constrained and developed river reaches and into less constrained reaches. New setback and cross levees are proposed to either create better riparian habitat or partition vulnerable islands. Setback levees were located on mineral soils along some channels where land surface elevations were generally less than five feet below sea level. Cross levees are located to efficiently partition islands and are mostly sited on mineral soils or along existing highway alignments. Highways were realigned on top of new levees to create elevated and more direct transportation corridors. Subsidence reversal marshes were located on the most deeply subsided organic soils.

Yolo Bypass/Cache Slough

Restore Floodplain Habitat and Improve Fish Migration Through the Yolo Bypass: There are approximately 15,000 acres of land in the inter-tidal/upland transition zone in the southeastern portion of the Bypass. Inundation of the Yolo Bypass provides excellent rearing habitat for juvenile salmon and splittail and critical spawning habitat for the splittail. Presently the bypass is only inundated once every three years on average and sometimes goes for four to five years without inundation. Increasing the frequency of inundation on even a small portion of the bypass could substantially improve rearing conditions for splittail and salmon and boost food production for the western Delta. Providing these flows would require notching or gating the Fremont Weir to allow a controlled inflow of water into the bypass in years when the stage of the Sacramento River is below the crest of the weir, or might also be achieved by using inflatable dams to back water onto the floodplain. The goal would be to create inundated floodplain habitat on a publicly owned portion of the bypass -- not privately owned land. Modification of the Fremont Weir could also allow improved fish migration through the bypass, permitting juvenile salmon to bypass the Delta cross channel and other hazards associated with migrating through the Delta. This project has been extensively studied by DWR and is called for by the PPIC report (p. 79) and the CALFED Ecosystem Restoration Program Plan. At the southern tip of the Bypass, on Liberty Island, natural restoration is rapidly resulting in tule marsh. The removal of the stair step levee system on the north end of Liberty could allow that restoration to continue well to the north.

Secure and Improve a Yolo Bypass/Cache Slough Habitat Corridor: This corridor extends from the confluence up the Sacramento River into Cache Slough and up the Yolo bypass toe drain encompassing both tidal channels and seasonally inundated floodplain. Improvement of this corridor would entail modifications of Fremont weir to facilitate movement of fish and flows through the bypass.

See Figure 1 on page 3 and figure 2 on page 4.

Figure 1: Yolo-Cache Slough Habitat Restoration Opportunities

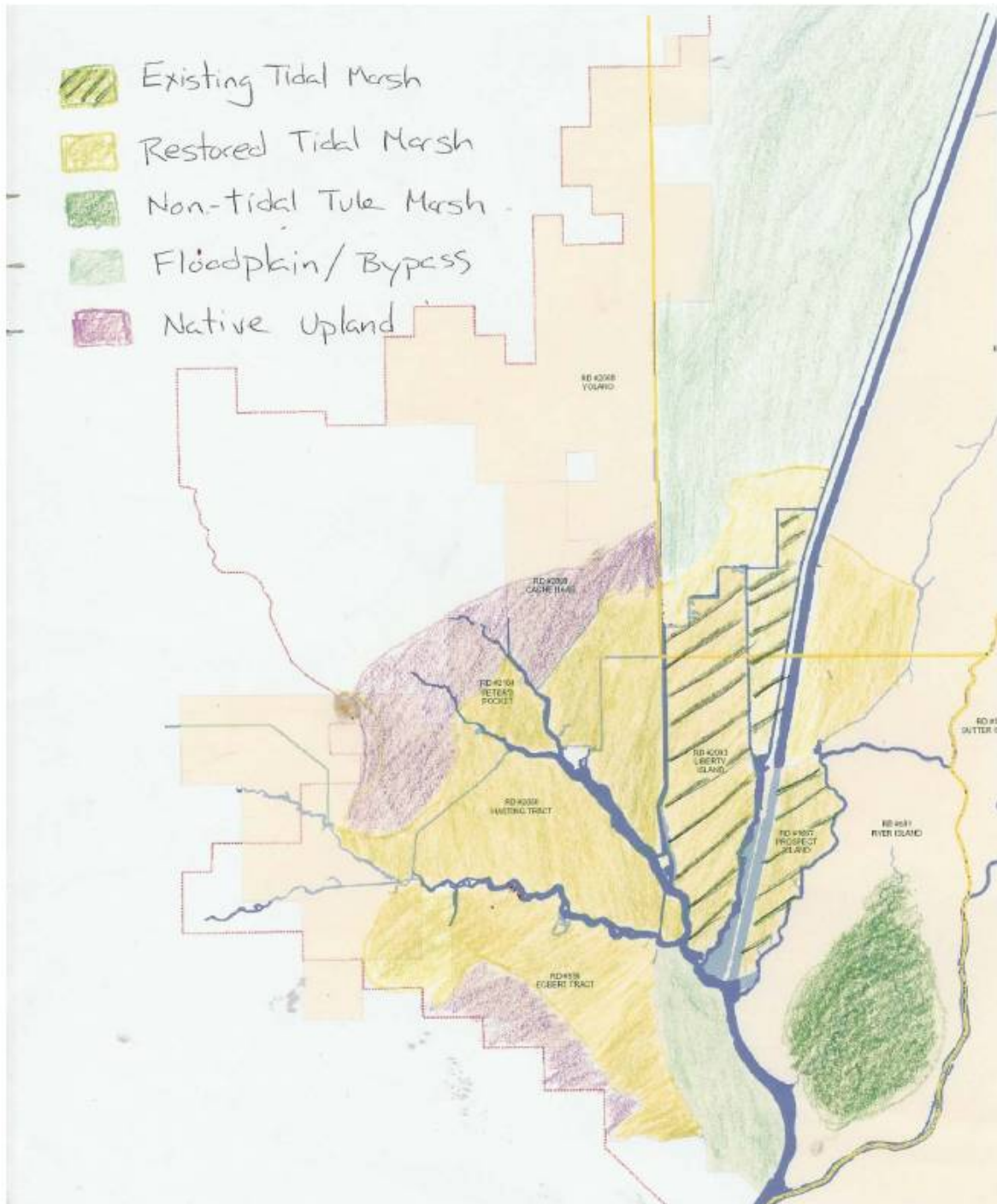
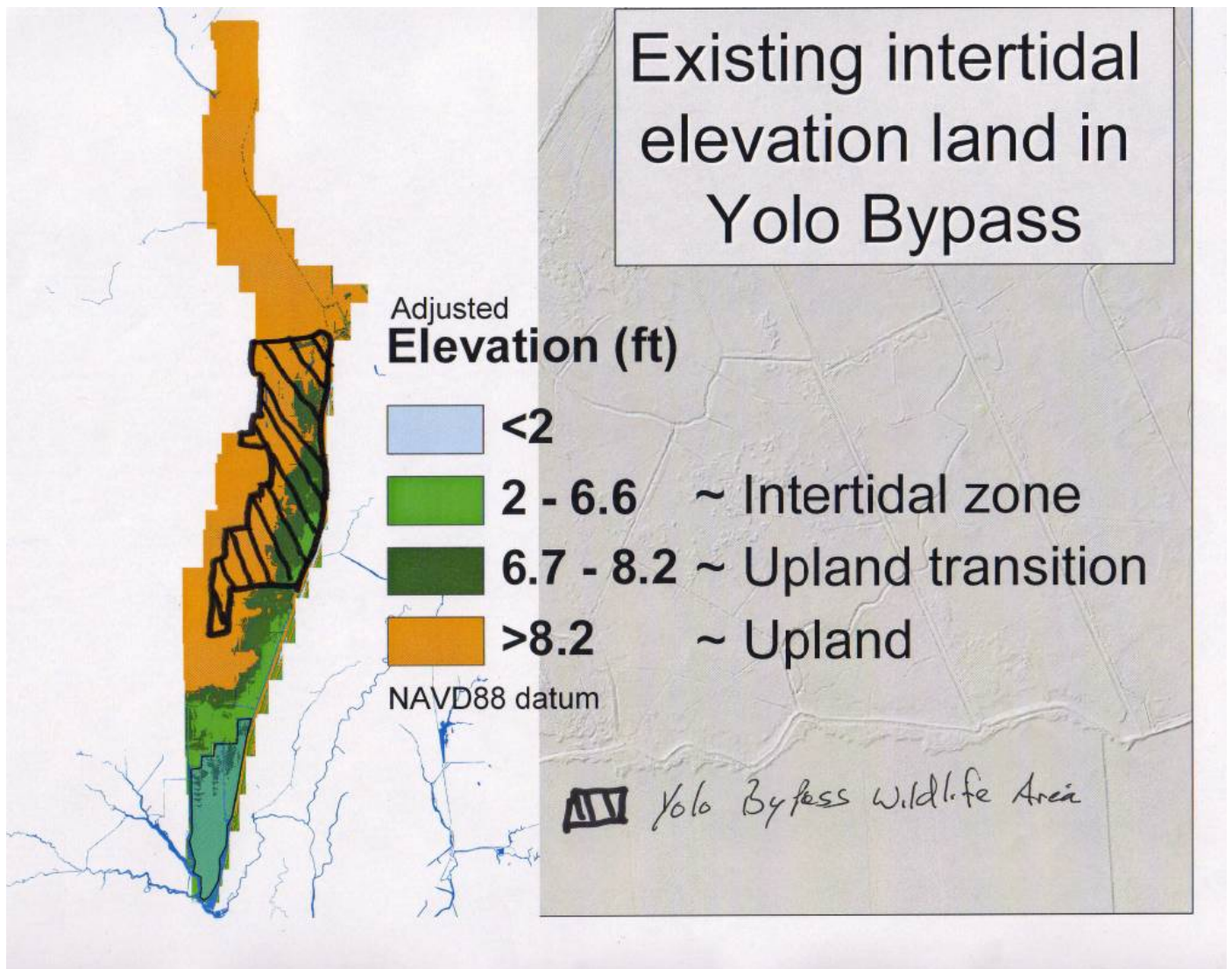


Figure 2: Yolo Bypass: Supplemental Map



North Delta

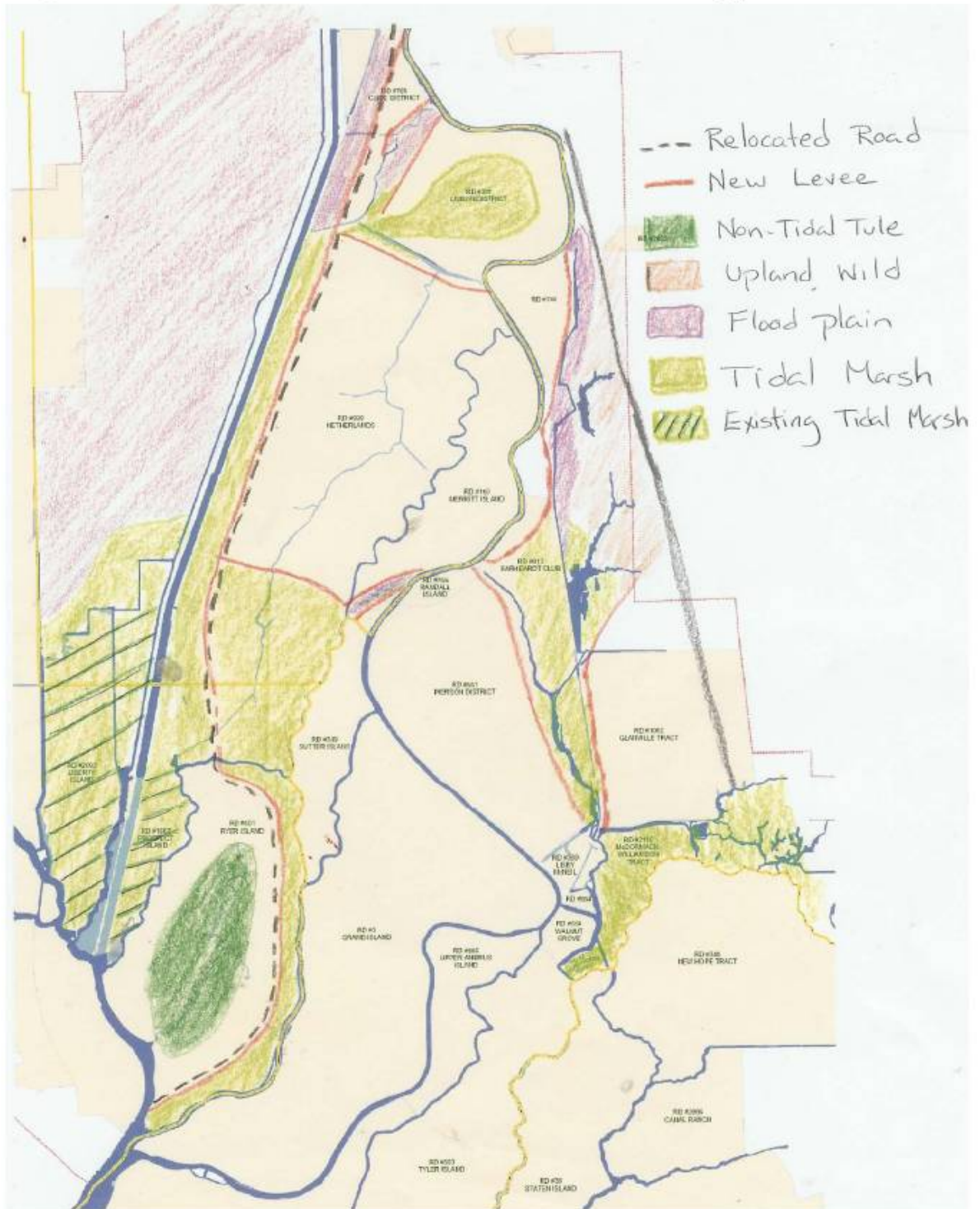
Cosumnes/Mokelumne Corridor: Extends from the Sacramento-San Joaquin confluence upstream along the San Joaquin and along both the north and south fork of the Mokelumne River up to the Cosumnes River Preserve and the spawning beds of the Mokelumne River. The corridor could also be broadened substantially from the channel for terrestrial benefits since it runs adjacent to the DWR and TNC owned lands on Sherman, Twitchell, Staten, and McCormick Islands

Stone Lakes and Snodgrass Slough Corridor: Reconnect Snodgrass Slough or sloughs along Stone Lakes Wildlife Refuge (at least seasonally) to the Sacramento River to create a corridor that extends from the Sacramento River near Hood downstream to the Mokelumne River at McCormack Williamson Tract. Such a corridor may require control gates or additional levees to prevent uncontrolled flooding.

Elk Slough: Reconnect Elk Slough to the Sacramento River near Clarksburg to create a corridor between the Sacramento River and Cache Slough via Miner Slough. Consider a similar linked corridor along Duck Slough to the west of Elk Slough. This option would require gates and levee improvements to prevent undesirable flooding.

See Figure 3 on page 6.

Figure 3: North Delta Flood and Habitat Corridor Opportunities



Western Delta

Acquire and Restore Decker Island: Decker Island is composed of old dredged spoils and, unlike other Delta islands, is several feet above sea level. Material from Decker Island should be excavated and used to reinforce and partition nearby Delta islands such as Sherman and Jersey. Excavation of Decker Island could result in approximately 400 acres of restored tidal marsh along the main migration corridor for juvenile salmon and Sacramento splittail.

Restore Habitat Along the Right Bank of the Sacramento River, at the Base of the Montezuma Hills, Between Rio Vista and Collinsville: Much of this shoreline was used to dispose of dredged materials in the past. It may be possible to excavate these materials and restore approximately 200 acres of tidal marsh.

Create a Three Mile and Seven Mile Sloughs Tidal Marsh Restoration Complex, composed of the following elements (800 – 1,000 acres):

- Excavate some or all of the land comprising Brannon Island State Park to create tidal wetlands and provide material for levee enhancement and island rebuilding on nearby Twitchell and Sherman Islands. Like Decker Island, Brannon Island State Park is located on millions of cubic yards of historical dredged materials, and together they account for approximately 85% of the dredged material above sea level in the western or central Delta. Excavating these materials may or may not involve relocating Brannon Island State Park since the park only lies over a portion of the fill material.
- Restore 150-300 acres of tidal marsh on the northeast tip of Sherman Island along Three Mile Slough. Much of this tip is already near sea level and could be restored to tidal marsh by creating a new cross levee to cut off the tip. With dredged material from Brannon Island, the area with elevations suitable for tidal marsh restoration could be substantially expanded.
- Restore linear tidal marsh along Seven Mile Slough between Twitchell and Brannon Islands. The north side of Twitchell Island is less than five feet below sea level. With material from Brannon Island, create a setback levee 1,000 feet south of the existing north levee and restore a 1,000-foot band of tidal marsh along approximately four miles of slough, creating approximately 500 acres of tidal marsh.
- Restore the southwest tip of Twitchell Island along the southern extent of Three Mile Slough. This would cut-off the tip, reducing the length of levee and restoring approximately 50 acres of tidal marsh.

Implement the Dutch Slough Tidal Marsh Restoration Project: The 1,200-acre Dutch Slough site was acquired by DWR in 2003. DWR and its partners have completed a restoration plan that is designed both to restore habitat and generate information about how best to restore Delta habitat in the future. The project is ready for implementation.

Restore Little Franks Tract to Tidal Marsh with Experimental Pilot Project to Float Submerged Peat Soil Profile: Little Franks Tract is currently flooded to a depth of 5-10 feet on average. Experience from the Montezuma Wetlands project in Suisun Marsh suggests that it may be possible to raise the submerged lands by injecting a fine clay dredged slurry under the peat. If this strategy proves successful at Little Franks Tract, it would have enormous implications for large-scale restoration of the deeply subsided central and western Delta islands.

Evaluate the Potential for Restoring Flooded Islands: Limited restoration of tidal marsh on submerged islands such as Franks Tract and Big Break could become an important component of long-term habitat restoration.

Strategically Rebuild and Restore Subsided Central and Western Delta Islands: Due to the vast volume of subsidence, it will not be feasible to restore all subsided islands in the next 50-100 years. Rather, efforts should be strategically focused in the western Delta or on the most deeply subsided portions of other Delta islands. Potential strategies for rebuilding subsided islands include:

- *Grow tules to reverse subsidence and sequester carbon:* A ten-year-long pilot project by USGS and DWR has shown that managed wetlands can raise island surface elevation by up to two inches per year, and in the process, sequester significant amounts of atmospheric carbon. Such a program should focus on publicly owned lands (e.g. Sherman, Twitchell, and Jersey Islands) as well as the deepest, most rapidly subsiding lands. This strategy need not necessarily convert entire islands to tule cultivation. For example, it could focus tule cultivation on the most rapidly subsiding portions of islands while accommodating wildlife friendly agriculture on adjacent fields. In addition to providing carbon offsets, such projects could provide significant habitat benefits and, by raising the elevation of subsided islands, could reduce the risks associated with potential Delta levee failures.
- *Reuse dredged materials:* Dredged material from the Delta channels, historical dredged spoil disposal sites, and San Francisco Bay could be used to strategically rebuild small portions of Delta islands. There is not enough dredged spoil to rebuild large areas. Decker Island and Brannon Island State Park are the best sources.
- *Use rice straw to rebuild islands:* Rice straw bales from the Sacramento Valley are abundant and sufficient to rebuild large areas of subsided islands.
- *Excavate Montezuma Hills:* The Montezuma Hills could provide a huge source of borrow material to substantially rebuild one or more Delta islands. It may be economical to slurry material from the Montezuma Hills to Sherman and Twitchell Islands over a period of years. Consolidation of peat soils under the load of mineral sediments is a potential problem that could be mitigated by combining the Montezuma slurry material with rice straw or tule cultivation.

Strengthen Levees with Borrow Material from Islands, Dredged Spoils, and Montezuma Hills: The general goal of strengthening levees should be to buy time to allow for longer-term efforts to rebuild Delta islands or otherwise create a more sustainable future. Maintaining levees would also protect wetland and waterfowl habitat on subsided Delta islands.

- *Increase toe berm mass:* Most levee failures are a result of piping or rotational slope failure. Increasing toe berm mass is the most effective strategy for reducing these failure modes. The expanded toe-berm mass can serve as a foundation for a setback levee.
- *Build green levees:* Growing vegetation on levees provides habitat benefits. On relatively wide levee cross sections, it may be possible to both harden the levee with rock and plant vegetation. This strategy may not be possible on the thin central and western delta levees where tree roots could facilitate piping or where high winds could blow over trees and precipitate levee failure.
- *Construct habitat set-back levees:* Construct new set back levees on the toe-berm, grade back the existing levee to create a riparian bench and plant with riparian vegetation. This technique was successfully employed on Twitchell Island and creates a 50 – 100 foot riparian edge in place of the existing rock slopes that characterize most central Delta levees today.

Plan for Failure: Anticipate levee failure and prepare islands accordingly to minimize impact and maximize benefits of flooding. Rebuilding Delta islands or portions of Delta islands is one way to create marsh or riparian habitat that could persist after a levee failure. Other strategies generally entail reinforcing the interior levee berms to prevent erosion on the levees, propagation of wind waves, and failure of other islands.

- *Place rock on interior levee berm slopes:* This approach prevents erosion of interior levee slopes if the island fails.
- *Construct interior tule berms (tule donuts):* Construct a berm parallel to the levee slope on the interior of the island and grade the zone between the berm and levee to approximately mean sea level. Cultivate tules on this zone. The result would be a ring of tules around the island – a “tule donut.” In the event of levee failure, tules will inhibit interior levee slope erosion and will provide some habitat benefits. More importantly, if properly designed to minimize wind wave fetch, tules will accrete over time to keep pace with sea level rise.
- *Plant trees near levee toe:* Plant trees at the base of interior levees to absorb wave action temporarily in the event of a levee failure. Trees would be inexpensive and provide habitat benefits, but would only prevent erosion temporarily until the island was reclaimed.
- *Construct wind wave fetch berms.* Construct berms above sea level and perpendicular to dominant wind direction to reduce wind wave fetch in the event of a levee failure.
- *Construct skeletal marsh template:* Construct a skeletal dendritic channel network on subsided islands that would provide tule lined channel habitat in the event of levee failure. Build earthen berms with a surface elevation of mean sea level to define

future channel networks and provide a substrate for tule growth. After levee failure, most of the island would be deeply flooded open water, but the skeletal channel network would diversify habitat and provide conditions for species that use tidal channels.

Intentionally Flood Subsidized Islands: Planned and controlled decommissioning of Delta islands could avoid the negative impacts of unplanned levee failure. Islands could be tidally inundated with a connection to surrounding tidal sloughs or non-tidally flooded and completely surrounded by levees. Armoring of interior levee slopes would be necessary for both tidal and non-tidal flooding regimes to prevent wind wave erosion.

- *Non-tidal flooding:* Non-tidal flooding of subsidized islands would lower the probability and substantially reduce the impact of levee failure. In the event of levee failure, water would not scour deep holes or rush into the island drawing seawater into the Delta. Repairing the levee to eliminate tidal connection would be relatively inexpensive. Preventing connection of tidal channels would prevent undesirable and irreversible hydrodynamic, water quality, and habitat changes associated with unplanned levee failure.

The on-site habitat or economic benefits of non-tidal flooding are unclear. Islands would be deeply flooded (5-20 feet) in order to minimize the impacts of levee failure and thus would not support large areas of emergent marsh or waterfowl habitat.

Some options that should be considered are: managing flooded islands for 1) water supply during droughts, 2) flood attenuation during peak tides, 3) aquaculture, 4) augmenting delta primary productivity by releasing nutrient rich waters at the right time to boost aquatic productivity, 5) recreation – water skiing, and 6) as an interim measure until we can accomplish a more productive and sustainable solution.

- *Uncontrolled tidal flooding:* Tidal flooding of subsidized islands could increase aquatic productivity and provide habitat for some species.
- *Controlled tidal flooding:* Use gates to control tidal flooding. It may be possible to periodically drain flooded islands for water supply or to control exotic species.

Partition Sherman, Jersey, and Bradford Islands: Partitioning islands with cross levees reduces the area that would be flooded by any one levee breach -- reducing the amount of salt water entrained, enabling vehicle access after a breach, and reducing the cost of rehabilitation. Sherman, Jersey, and Bradford Islands are ideal candidates for partitioning due to their location in the western Delta and the presence of relatively high mineral soils suitable for constructing cross levees. Once the islands are partitioned, various portions could be managed for different purposes such as agricultural wetlands, recreation, or subsidence reversal tule ponds.

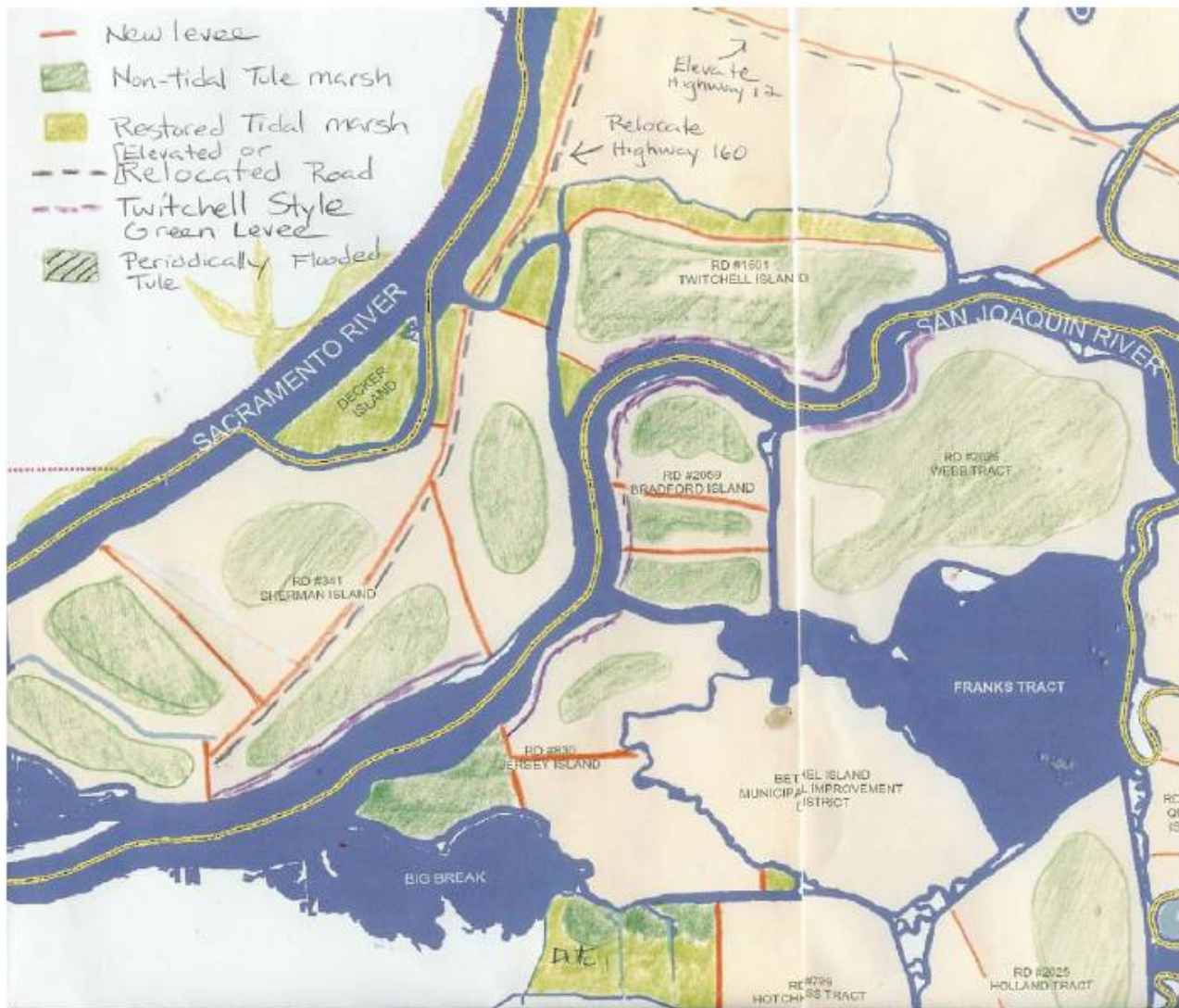
- *Partition Sherman Island:* Partitioning Sherman Island would protect State Highway 160 and reduce the water quality consequences of levee failure. Protecting 160 would greatly facilitate emergency response in the event of a failure on part of Sherman. Material from nearby Decker Island or the Montezuma hills could be slurried across the Sacramento River and used in combination with tule cultivation or rice straw bales to rebuild individual cells back to sea level over time. Over the near

term, some portions of the island could be rebuilt to tidal marsh as described in the habitat restoration section above. Most of Sherman Island is owned by DWR.

- *Partition Jersey Island:* Jersey Island is owned by the Ironhouse Sanitary District, which is interested in partitioning the island and implementing a large-scale subsidence reversal project on the northwest peninsula. Less than 2 miles of cross levee on Jersey Island would divide the island into three equal parcels.
- *Partition Bradford Island:* Two linear bands of elevated, mineral soil across Bradford Island provide foundation materials for two cross levees that would divide Bradford into three sections. The Port of Stockton owns large portions of Bradford, but there are still several private land holdings.

See Figure 4 on page 12.

Figure 4: Western and Central Delta Habitat Restoration, Subsidence Reversal, and Island Partitioning Opportunities



South Delta Bypass and Old River Corridor

Mainstem San Joaquin River: Currently serves as primary migration route for San Joaquin River salmon. Extends from confluence with the Stanislaus downstream past the Port of Stockton where the deep-water ship channel creates low dissolved oxygen problems. The lower reach includes rare fragments of tidal marsh habitat.

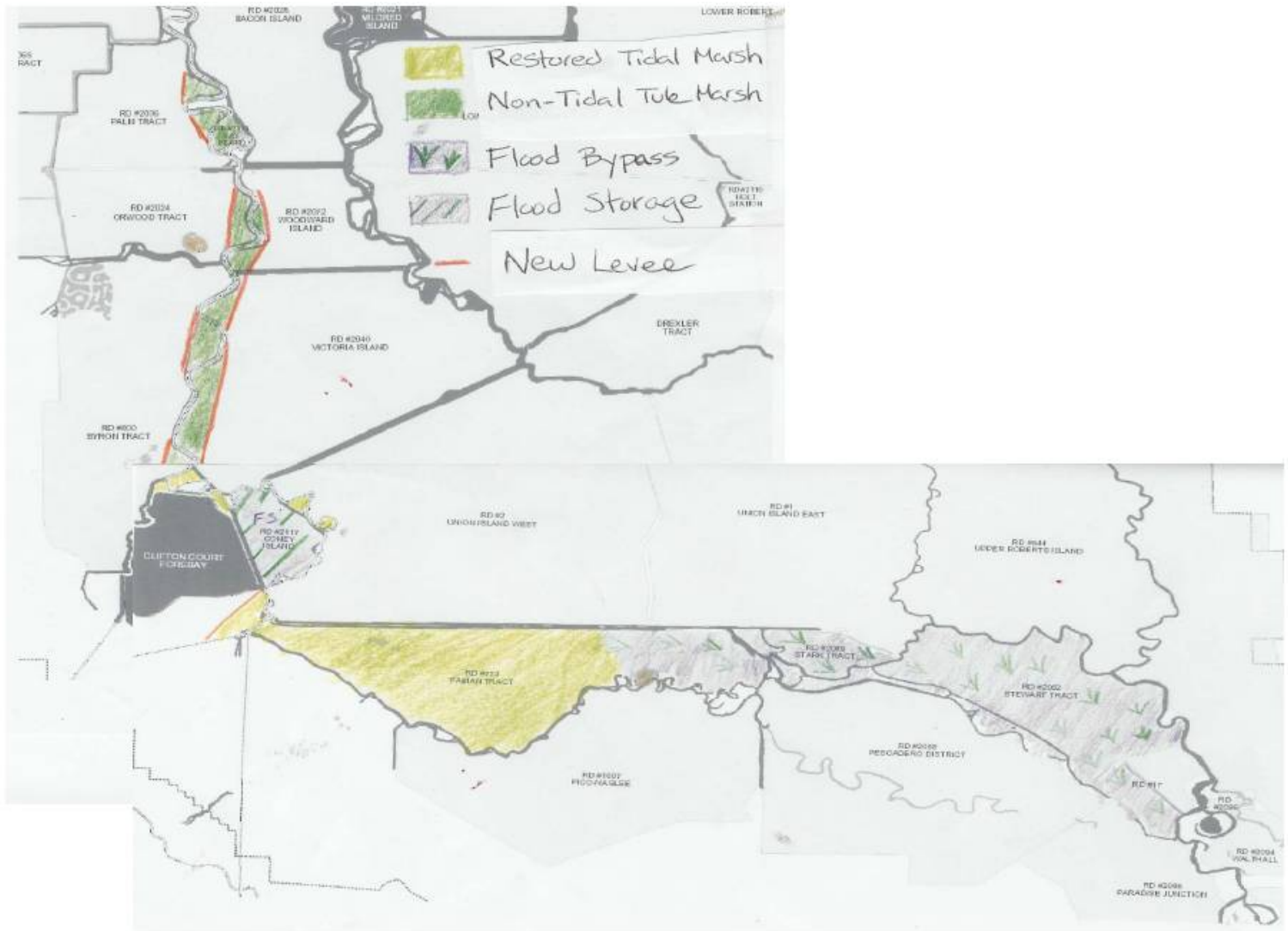
Middle River/South Delta Flood Bypass Corridor: This corridor would extend along Middle River and could include creation of a flood bypass on Stewart Tract (see below). Creation of the corridor could require channel expansion or levee setback along the Middle River channel. Under existing conditions, the barrier at the head of Old River seasonally blocks this channel. Creation of this corridor would allow fish to migrate around the Stockton Deep Water Ship Channel.

Old River Corridor: This corridor would route fish along Old River and away from the Stockton Deep Water Ship Channel. In order to be effective, the corridor would need to be modified to allow safe fish passage past the state and federal pumps.

South Delta Floodway: Construct a South Delta Floodway to attenuate flood flows and redirect floodwaters away from the developed communities of Stockton and Lathrop. Stewart Tract is the best site to locate a bypass. A South Delta Bypass and Floodway would provide ecological benefits for numerous covered species, would increase food supply for the central and western Delta, and would reduce the potential for harmful levee failure resulting from high inflows on the San Joaquin River. In addition to benefits for Delta communities, Delta agriculture and export reliability, a floodway could provide help preserve Delta agricultural land and help reduce urbanization in deep floodplains in the South Delta.

See Figure 5 on page 14.

Figure 5: South Delta Flood Bypass and Old River Corridor



Suisun Marsh/Suisun Bay

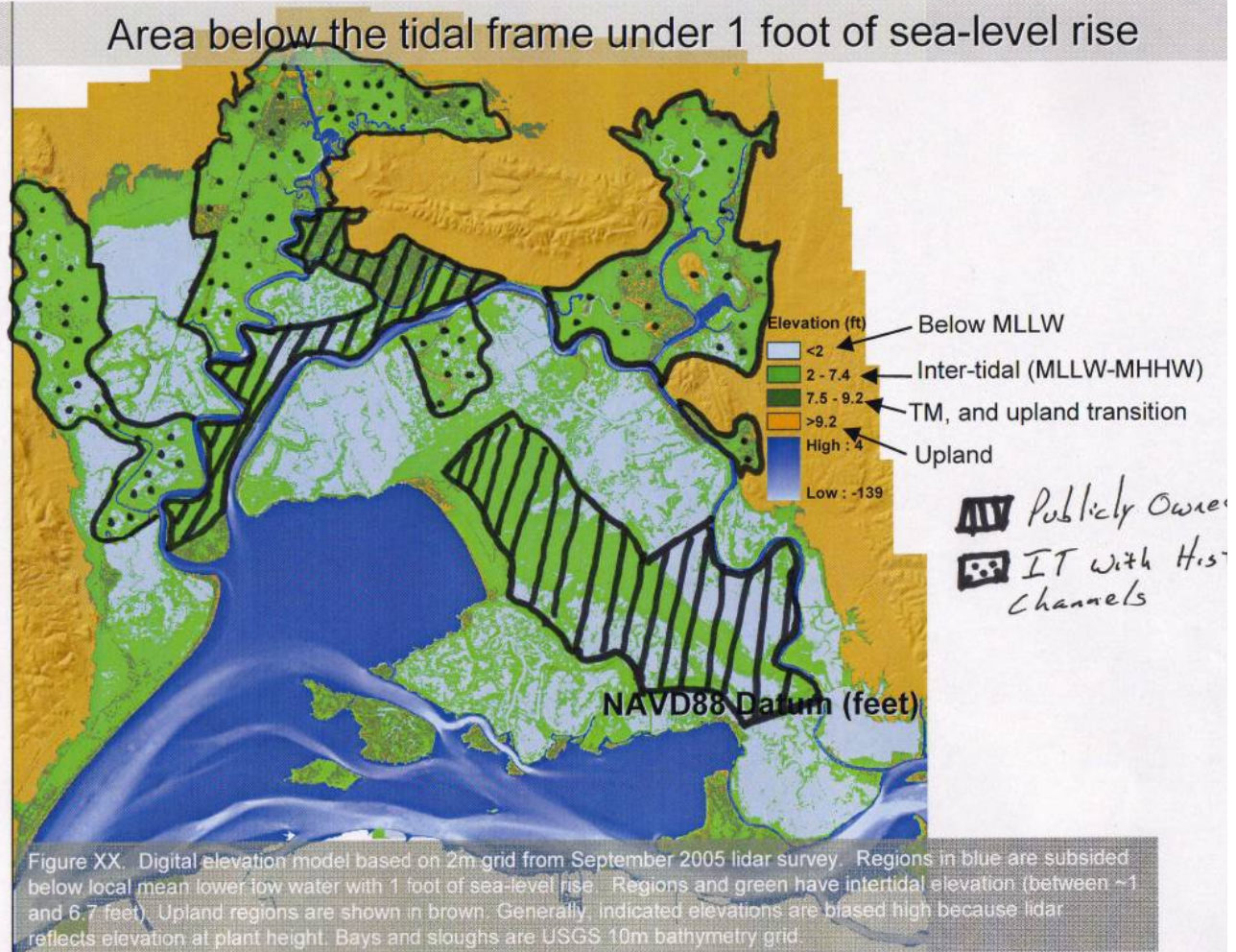
Suisun Marsh Perimeter: Lands along the northern edge of Suisun Marsh are less subsided than lands in the interior marsh and therefore most suitable for near term restoration. DWR's Miens Landing project is one example of the potential to restore managed seasonal wetlands to tidal marsh. Several planning efforts by state and federal agencies and the Suisun RCD have already begun to map out future management opportunities. Potential loss of managed freshwater and brackish seasonal wetlands would need to be offset by restoration of such habitats elsewhere in the Central Valley or coastal areas.

Suisun Marsh Interior: Lands in the central and southern parts of the marsh, while more subsided than the perimeter, will still be easier to restore than the deeply subsided western Delta. Furthermore, a substantial portion of these lands is publicly owned. Near term management designed to reverse subsidence would improve longer-term prospects for tidal marsh restoration. Van Sickle Island, recommended for tidal marsh restoration in the PPIC report, is one example.

Southern Suisun Bay Shoreline: This shoreline lies on the northern edge of Contra Costa County and encompasses many acres of former and existing tidal wetlands, yet has not received much attention as a restoration opportunity. The remnant marshes along the edge of the Concord Naval Weapons station are one example of such an opportunity.

See Figure 6 on page 16.

Figure 6: Suisun Marsh/Suisun Bay



A LONG-TERM VISION FOR THE DELTA

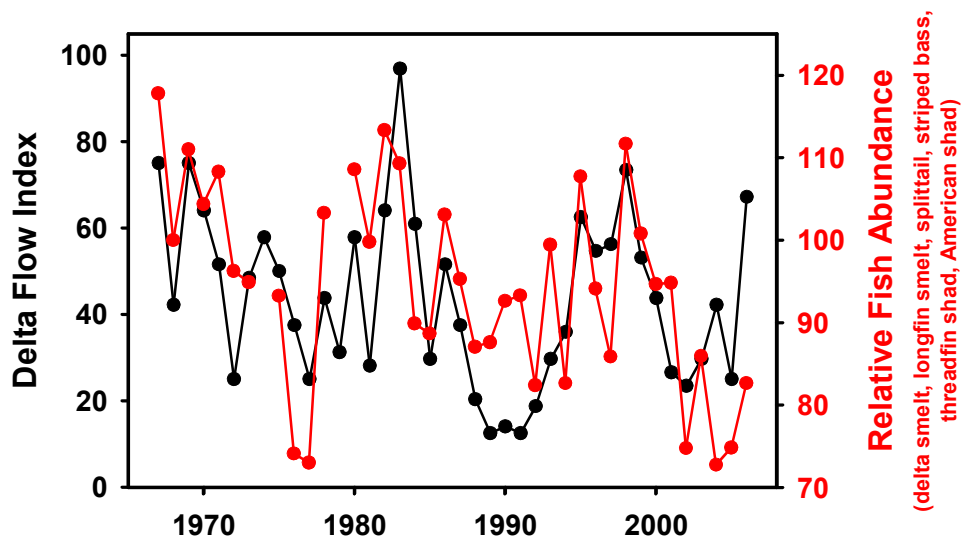
Attachment 2: Simulating More Natural Flow Conditions

The targets for Delta flow conditions described here are intended to demonstrate how and to what extent the current Delta hydrograph (i.e., the timing, duration and magnitude of inflows, outflows and in-Delta circulation governed by reservoir releases, uncontrolled runoff, and operations to divert or export water) needs to be reshaped to ensure habitat conditions sufficient to support self-sustaining populations of native fish and other aquatic organisms. These targets should be refined in conjunction with potential future changes to Delta hydrology, physical habitat, and infrastructure and in consideration of impacts to ecological conditions upstream of the Delta.

In considering how the natural hydrograph has been altered by storage, diversions and exports over time, and how we propose to reshape it, it is essential to understand three overarching facts about the Delta:

1. The health of the Delta ecosystem tracks flow conditions. As Delta flows have been altered and reduced, the abundance of Delta fish populations has correspondingly declined (Figure 1).

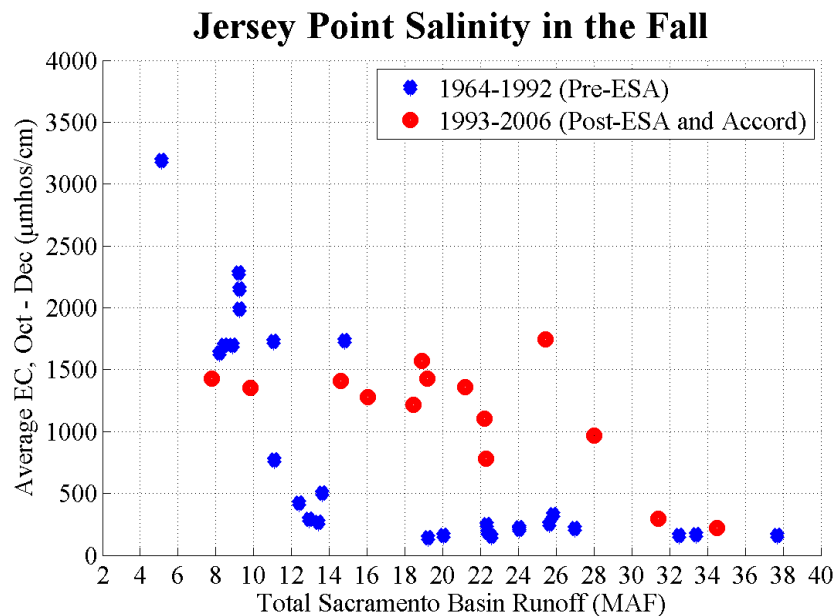
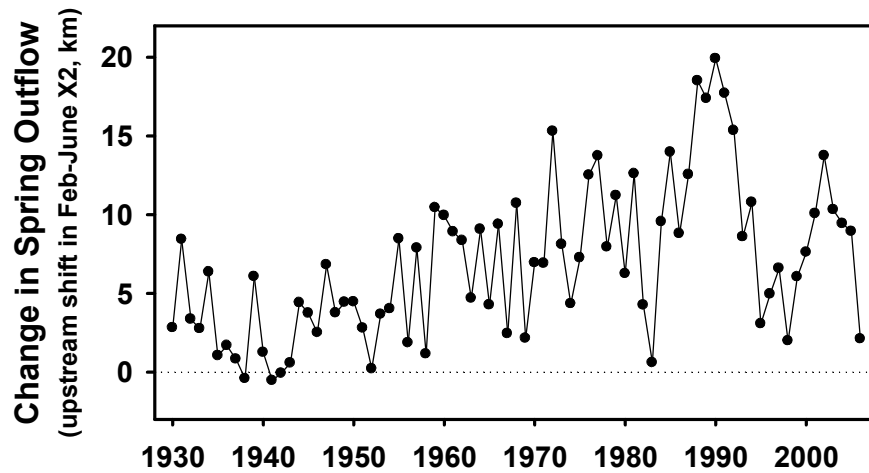
Figure 1: Eight Flow Indicators Plotted Against Delta Fish Abundance



Delta flow conditions, shown here as the multi-metric Delta Flow Index, are highly correlated with the abundance of multiple Delta fish species, shown here is the relative abundance (i.e., relative to their 1967-1976 average) of the six pelagic fish species surveyed by the Fall Midwater Trawl survey and for which abundance indexes are calculated. The Delta Flow Index aggregates the results of eight quantitative indicators that measured Delta inflows, outflow, channel hydrodynamics, and flow-related ecological conditions. Data sources: California Department of Water Resources, Dayflow and Central Valley Unimpaired Streamflow datasets, and California Department of Fish and Game, Fall Midwater Trawl Survey.

2. Natural salinity fluctuation has decreased, because the system has become more saline over time (Figure 2).

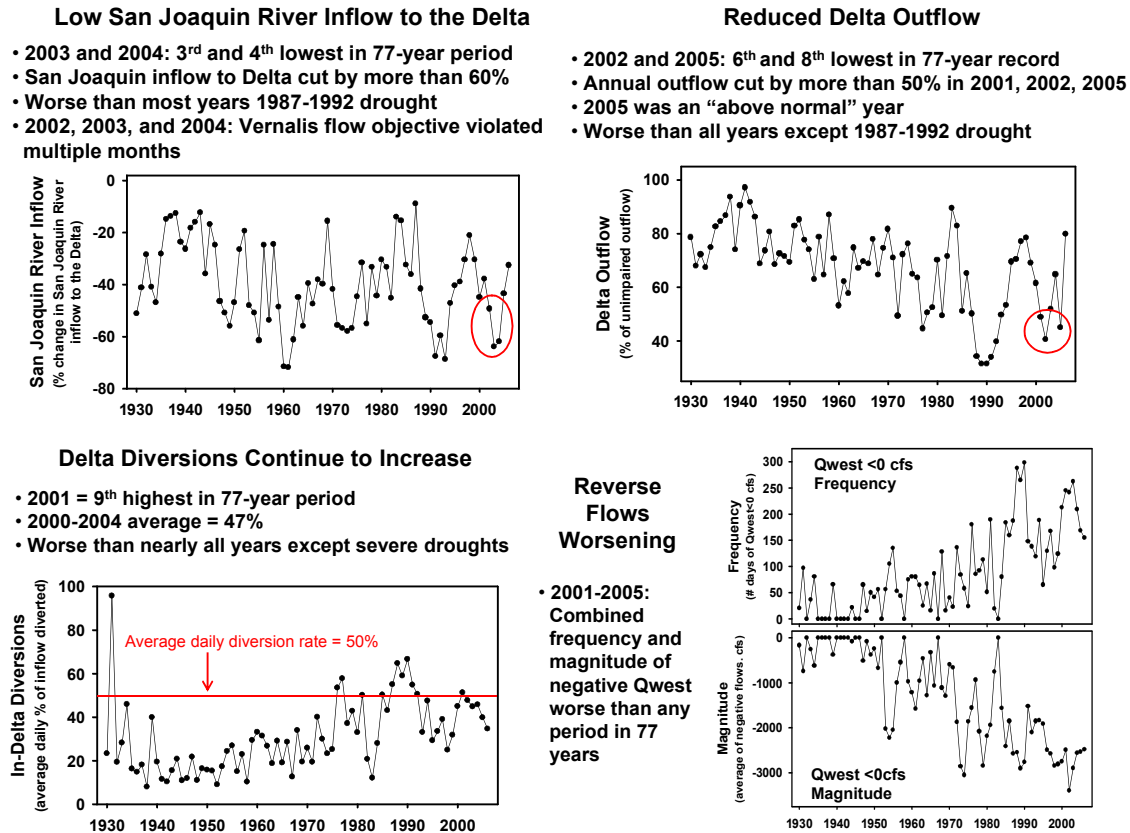
Figure 2: The Delta is more saline, not less, compared to historic conditions



During the spring, reduced Delta outflows have shifted low salinity habitat, denoted by X2, far upstream (top panel: California Department of Water Resources, Dayflow and Central Valley Unimpaired Streamflow dataset). Similarly, during the fall reduced outflows have increased salinity (as electrical conductivity) measured at Jersey Point in all but the wettest years since 1993 (bottom panel; data source: Contra Costa Water District).

3. Despite the attention given to the Delta in recent years, flow conditions have significantly worsened in recent years (Figure 3).

Figure 3: Four Indicators of Deteriorating Delta Flow Conditions

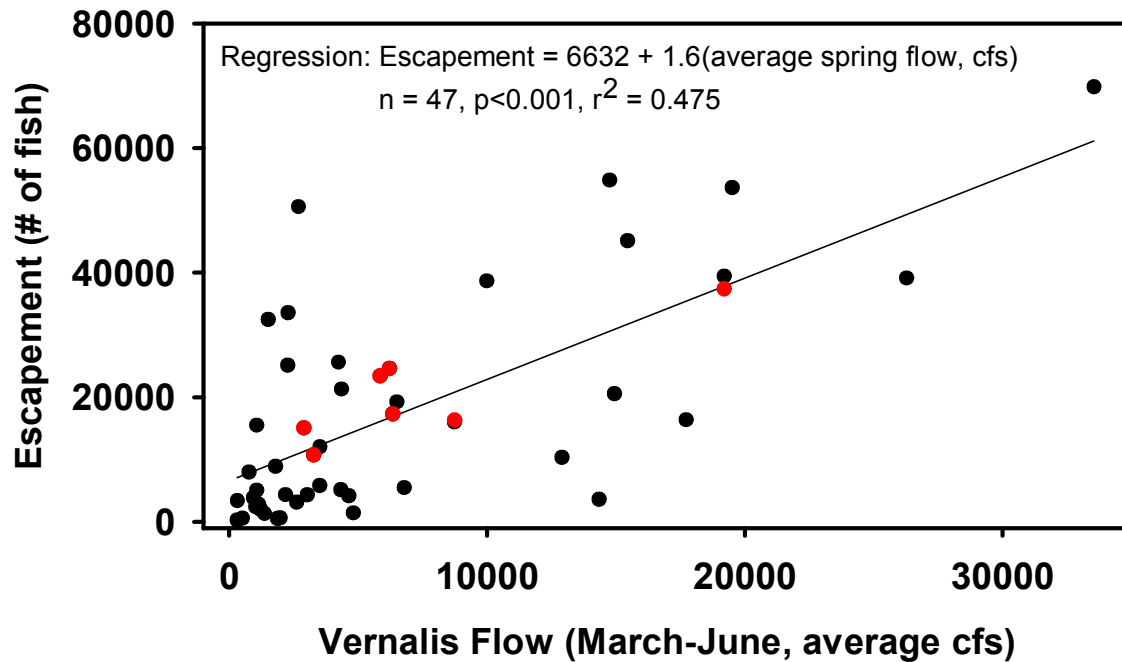


These four indicators from the Delta Flow Index show that freshwater inflows from the San Joaquin basin into the Delta reached near record lows in several years during the 2000s (top left panel), freshwater outflows from the Delta were lower than for all years except the 1987-1992 drought (top right panel), in-Delta diversion rates were higher than for nearly all years except during the 1987-1992 drought (bottom left panel), and both the frequency and magnitude of reverse flows on the lower San Joaquin River were worse than for any period in the 77-year record. Data source; California Department of Water Resources, Dayflow and Central Valley Unimpaired Streamflow dataset.

For more information on flow conditions and targets, see the Bay Institute’s San Francisco Bay Index (http://bay.org/ecological_scorecard.htm), the Year in Water Report (<http://bay.org/news.htm>) and the Sacramento-San Joaquin Delta Index (in press).

Delta Flow Targets					
Water Year type (Based on Sacramento or San Joaquin Index, as appropriate. Objectives for Oct.-Jan to be based on water year type of previous year)	W	AN	BN	D	C
Delta Inflows					
Sacramento River (at Rio Vista)					
July-Aug.	7000 cfs	6000 cfs	5000 cfs	5000 cfs	3000 cfs
Sept.	6000 cfs	5000 cfs	5000 cfs	4000 cfs	1500 cfs
Oct.-Jan.	7000 cfs	6000 cfs	6000 cfs	5000 cfs	3000 cfs
<u>Biological rationale:</u> Higher summer and fall Sacramento River flows contribute to improved Delta outflow conditions, improved habitat quality, and high abundance of juvenile delta smelt (see Delta Outflow, below). For critical (C) years, September objective designed to allow salinity intrusion into Delta to increase seasonal variation in salinity and outflows and for potential control of some non-native plant and animal species (i.e., as recommended by PPIC report, 2007).					
Yolo Bypass (Feb-May) (discharge from Yolo Bypass into Cache Slough)	30,000 cfs (for 45 consecutive days)	20,000 cfs (for 45 consecutive days)	10,000 cfs (for 45 consecutive days)	5,000 cfs (for 45 consecutive days)	1000 cfs (for 30 consecutive days)
<u>Biological rationale:</u> Seasonal long-duration inundation of floodplain has been shown to be highly beneficial for outmigration, survival and growth of Sacramento basin Chinook salmon, spawning and recruitment of splittail, and production and export of phyto- and zooplankton to the north Delta (Sommer et al. 2001. Fisheries 26(8):6-16). There is presently no objective for flow through and discharges from the Yolo Bypass into the Delta. Sacramento and Fremont Weir facilities would need to be modified to allow diversion of water from the river into the bypass under a range of Sacramento River flow conditions; and passage facilities constructed at one or both weirs for upstream migrant fishes (e.g., sturgeon).					
San Joaquin River (at Vernalis)					
Feb.	3420 cfs	3420 cfs	2280 cfs	2280 cfs	1500 cfs
March	5000 cfs	5000 cfs	3420 cfs	2280 cfs	1500 cfs
April 1-4	7000 cfs	5000 cfs	5000 cfs	5000 cfs	2000 cfs
April 15-May 15	VAMP*	VAMP*	VAMP*	VAMP*	VAMP*
May 16-31	7000 cfs	5000 cfs	5000 cfs	3420 cfs	2000 cfs
June	5000 cfs	5000 cfs	3420 cfs	2280 cfs	1500 cfs
July-Jan.	1500 cfs	1500 cfs	1500 cfs	1500 cfs	1200 cfs
* VAMP = April 15 – May 15. Flow objectives determined by San Joaquin basin unimpaired hydrology and the VAMP experiment design <u>Biological rationale:</u> Statistical relationship between spring flow and escapement of San Joaquin basin Chinook salmon 2.5 years later (analysis by TBI 2005 for the SWRCB review of Bay-Delta Water Quality Control Plan). Minimum flow for summer, fall and winter to maintain suitable dissolved oxygen conditions in SJR between Turner Cut and Stockton (see Dissolved Oxygen, below). See Figure 4.					

Figure 4: Higher San Joaquin Spring Flows = Higher Salmon Survival



Survival and escapement of San Joaquin basin fall run Chinook salmon is higher when springtime flows on the San Joaquin River measured 2.5 years earlier, when the juveniles emigrated to the ocean, are high. Escapement is high and population growth is positive (i.e., a cohort replacement rate greater than 1, not shown here) when San Joaquin River flows are at least 5000 cfs. Red circles are for years since the implementation of the 1995 Bay-Delta Plan (through 2004 escapement only). Data sources: California Department of Fish and Game, salmon escapement dataset, "Grandtab", and the California Department of Water Resources, Dayflow.

Delta Outflow

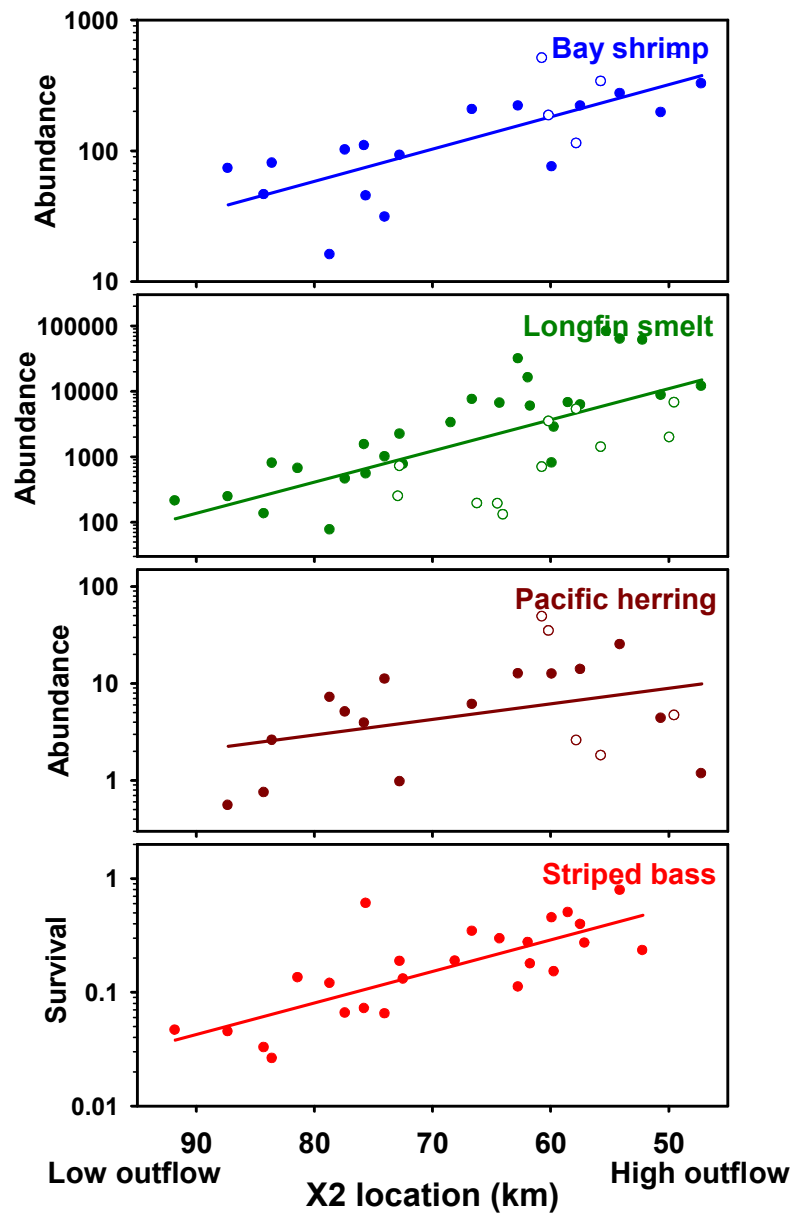
Delta Outflow (spring and fall) is expressed in terms of seasonal or monthly average and/or ranges of X2 values. Specific monthly flow requirements would need to be computed based on upstream unimpaired hydrology (e.g., for spring outflows, similar as for current WQCP objectives) and/or the flow-X2 equations.

Spring Outflow (Feb-June) (mean, range)	60 km (57-63 km)	63 km (60-66 km)	66 km (63-69km)	70 km (67-73 km)	73 km (70-76 km)
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Range of X2 reflects variation in hydrology within each water year type. Within the five month period, required flows (and resultant X2 values) will vary by month, with higher flows (and lower monthly average X2 values) required during the early spring period than during the later spring period (i.e., similar to spring outflow objectives in the current SWRCB Bay-Delta Water Quality Control Plan).

Biological rationale: Strong statistical relationship between X2 location and abundance and/or survival of numerous estuarine fish and invertebrate species (see, e.g., Jassby et al. 1995; Kimmerer 2004). Current spring outflow objectives are insufficiently protective (i.e., correspond to low abundance and/or survival of several priority species) in critical, dry, and below normal year types under existing storage and diversion constraints. Current objectives for wetter years would be insufficiently protective if storage and diversion capacity were increased (decreasing the magnitude and frequency of “excess” flows in wetter years that significantly improve ecological conditions to the estuary). See Figure 5.

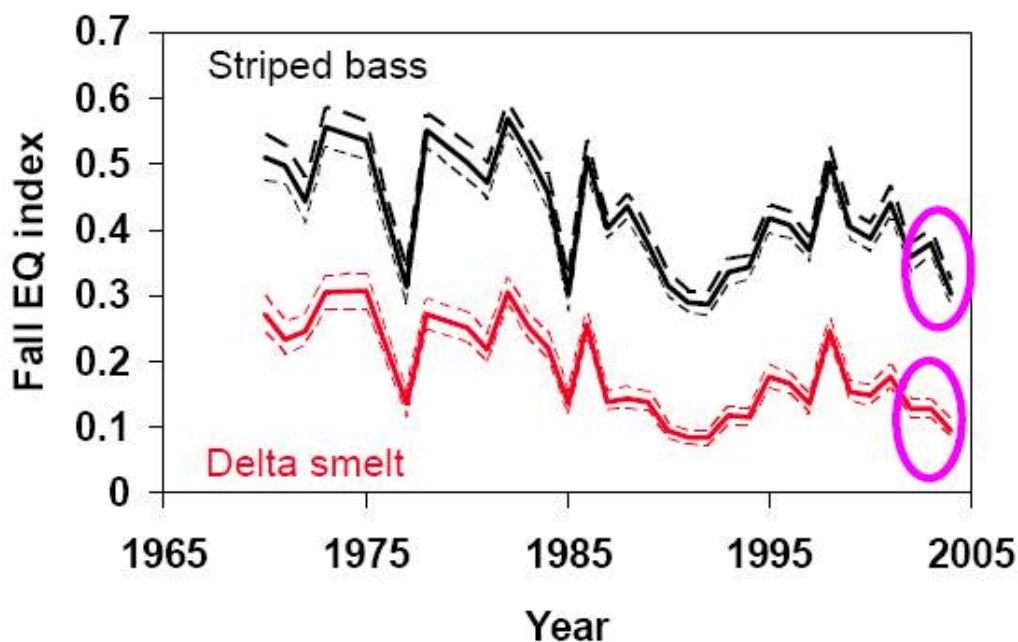
Figure 5: Higher Spring Outflows = Higher Abundance of Delta Aquatic Species



The abundance and survival of many Bay-Delta fish and invertebrate species is strongly affected by the amount of freshwater outflow from the Delta during the spring. In years when spring outflows are high and X2 is located downstream (i.e., low X2), abundance and survival are high; in years with low spring outflow (i.e., high X2), abundance and survival are low. Data sources: California Department of Fish and Game, Fall Midwater Trawl Survey, and Dr. W. Kimmerer, San Francisco State University, Romberg Tiburon Laboratory.

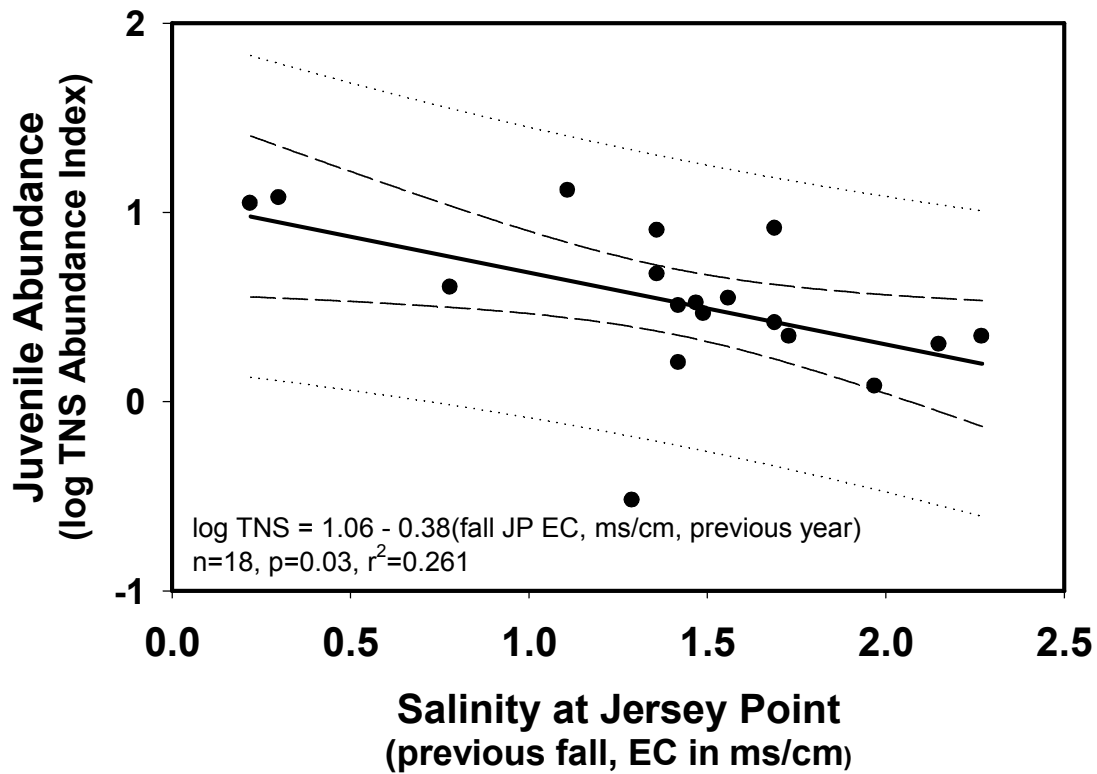
Fall Outflow Sept.-Dec. Sept. Oct.-Dec.	<80 km	<80 km	<80 km	<84 km	>100 km* <84 km
<p>* 3-day running average of X2 >100 km for 7 consecutive days during the month of September.</p> <p><u>Biological rationale:</u> POD research on habitat quality index during the fall (i.e., low habitat quality for delta smelt in fall related to reduced outflows and upstream location of X2; see Sommer 2007); statistical relationship between abundance of juvenile delta smelt and fall salinity (i.e., reduced outflow during fall correlated with lower abundance of juvenile delta smelt; see Contra Costa Water District, 2006 and 2007). For critical (C) years, the September objective is designed to allow salinity intrusion into Delta to increase seasonal variation in salinity and outflows and for potential control of some non-native plant and animal species (i.e., as recommended by PPIC report, 2007). Current fall outflow objectives allow intrusion of X2 upstream of 80 km in all year types, conditions known to be related to poor habitat quality (for delta smelt and striped bass) and low abundance of juvenile delta smelt the following year. Objective for September in critical years provides opportunity to create more saline conditions in the Delta than presently allowed to increase seasonal and inter-annual salinity variation. See Figures 6 and 7.</p>					

Figure 6: Decline in Fall Habitat Quality



Habitat quality, a combined measure of salinity, temperature and turbidity, for delta smelt and juvenile striped bass during the fall has declined. For delta smelt, the key driver for the declining habitat quality is elevated salinity resulting from reduced freshwater outflows during the fall. See also Figure 2 above. Source: Sommer 2007, presentation to the State Water Resources Control Board, March 2007, and Feyrer, F. B, M. L. Nobriga, and T. R. Sommer. 2007. Multi-decadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA. *Canadian Journal of Fisheries and Aquatic Sciences* 64:723-734.

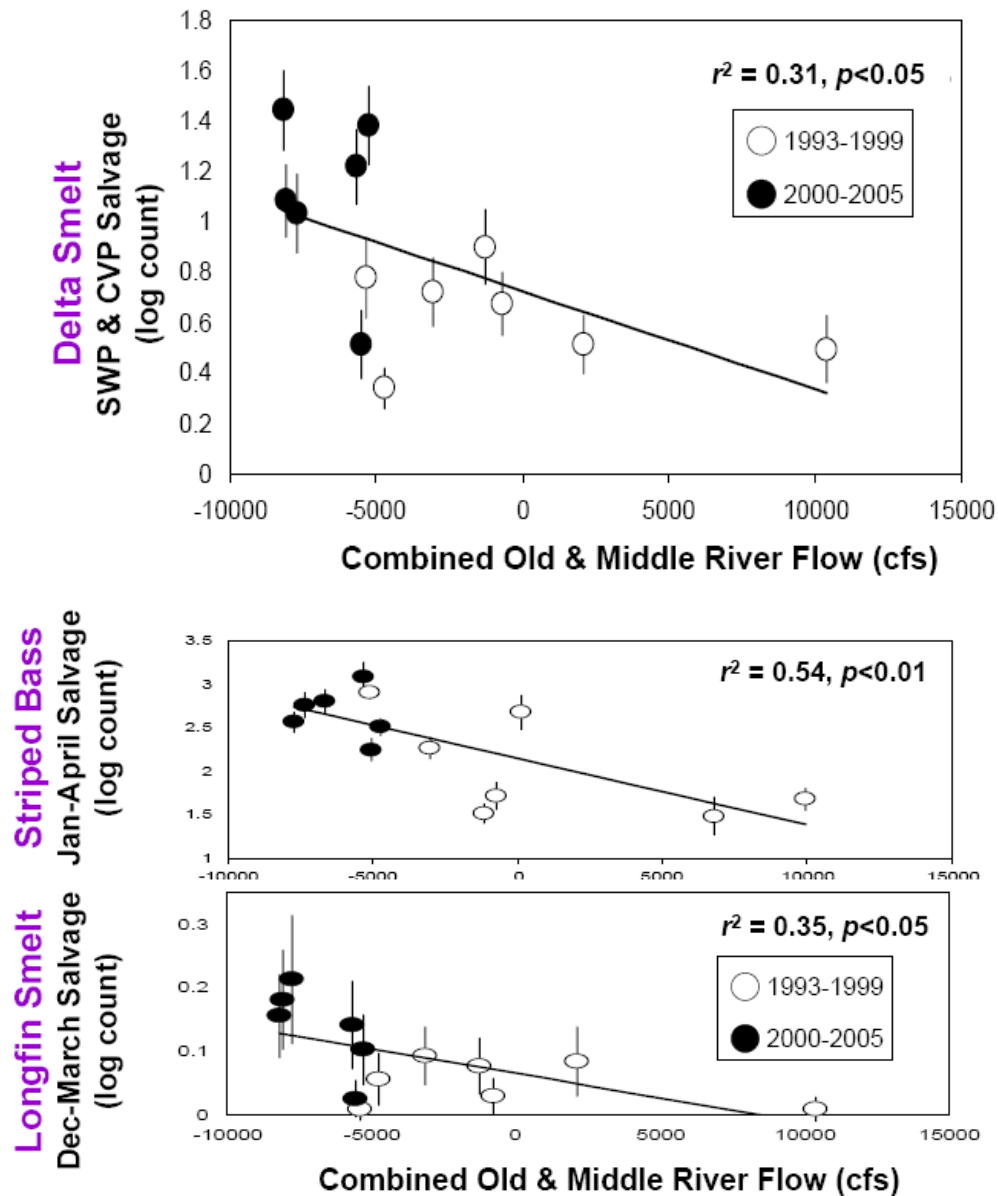
Figure 7: High Fall Salinity = Low Smelt Abundance



Elevated salinity during the fall is significantly correlated with the abundance of juvenile delta smelt. When fall salinities are low and Delta outflows are high, the abundance of juvenile delta smelt measured the following year is higher than in years when fall salinity is high and Delta outflows are low. Data sources: California Department of Fish and Game, Summer Townet Survey, and Contra Costa Water District, Jersey Point EC)

In-Delta Channel Flows					
Qwest (at Jersey Point)					
Feb.-June	>0 cfs	>0 cfs	>0 cfs	>-1000 cfs	>-1500 cfs
July-Aug.	>0 cfs	>0 cfs	>-1000 cfs	>-2000 cfs	>-2500 cfs
Sept.	>0 cfs	>0 cfs	>-1000 cfs	>-2000 cfs	>-3000 cfs
Nov.-Jan.	>0 cfs	>0 cfs	>-1000 cfs	>-2000 cfs	>-2500 cfs
<u>Biological rationale:</u> Negative Qwest correlated with low inflows from the San Joaquin, Cosumnes, and Mokelumne Rivers, high exports and Delta diversions, and Delta Cross channel operations. Negative Qwest conditions prevent downstream transport and facilitate upstream entrainment of small fish and plankton into the central and southern Delta, increasing vulnerability to their loss at the export pumps.					
Old/Middle River (combined flow)					
Jan.-March	>0 cfs	>-1500 cfs	>-1500 cfs	>-3500 cfs	>-3500 cfs
April 1-14	>0 cfs	>0 cfs	>0 cfs	>-1500 cfs	>-1500 cfs
April 15-May 15	>0 cfs	>0 cfs	>0 cfs	>-1500 cfs	>-1500 cfs
May 16-31	>0 cfs	>0 cfs	>-1500 cfs	>-1500 cfs	>-1500 cfs
June	>0 cfs	>0 cfs	>-1500 cfs	>-3500 cfs	>-5000 cfs
July-Dec.	>-3500 cfs	>-3500 cfs	>-5000 cfs	>-5000 cfs	>-5000 cfs
<u>Biological rationale:</u> Negative flows on Old and Middle River are correlated with export rates, San Joaquin River inflows, and operations of the Head of Old River barrier and south Delta agricultural barriers. High magnitude reverse flows on Old and Middle River are correlated with high incidental take of adult delta smelt, longfin smelt and other priority species. For delta smelt and longfin smelt, winter and spring period coincide with presence of pre-spawning and spawning adult fish, larvae and small juveniles in the Delta (POD results, see Sommer 2007, and Pelagic Fish Action Plan. See Figure 8.					

Figure 8: High Reverse Flows = High Delta Fish Take at CVP/SWP Pumps



For several priority Delta fish species, the numbers of fish taken at the SWP and CVP export facilities is directly related to the magnitude of negative (or reverse) flow in Old and Middle River channels that lead directly to the pumps. Source: Sommer 2007, presentation to the State Water Resources Control Board, March 2007.

Diversions and Exports					
Export/SJR inflow ratio (as CVP+SWP exports/total San Joaquin River flow at Vernalis)					
Feb.-March	2.0	2.0	2.0	2.0	2.0
April 1-14	1.0	1.0	1.0	1.0	1.0
April 15-May 15	VAMP*	VAMP*	VAMP*	VAMP*	VAMP*
May 16-31	1.0	1.0	1.0	1.0	2.0
June	2.0	2.0	2.0	3.0	3.0
<p>* VAMP = April 15 to May 15. Flow objectives determined by San Joaquin basin unimpaired hydrology and the VAMP experiment design</p> <p><u>Biological rationale:</u> Statistical relationship between San Joaquin River spring flow, exports and escapement of San Joaquin basin Chinook salmon 2.5 years later (analysis by TBI 2005 for the SWRCB review of Bay-Delta Water Quality Control Plan). High Export/SJR inflow ratios also contribute to high magnitude reverse flows on Old and Middle River and resultant high incidental take of multiple priority fish species. Greater protection is provided in the later winter/early spring period (pre-VAMP) for spawning and early rearing of delta and longfin smelt.</p>					
Export/Inflow ratio (as CVP+SWP exports/total Delta inflow)					
Dec.-March	0.20	0.20	0.20	0.20	0.20
April-June	0.20	0.30	0.30	0.35	0.35
July-Nov.	0.50	0.50	0.60	0.65	0.65
<p><u>Biological rationale:</u> For winter (when adult delta and longfin smelt move into Delta to spawn), statistical relationship between E/I ratio and longfin smelt abundance measured later in the year (LFS abundance is higher when E/I previous winter is low, with an apparent threshold at approximately 0.20; TBI 2007). For spring, summer and fall, current E/I ratio objective. In wet years, the maximum annual proportion of inflow exported is 0.325; in dry and critical years, the maximum annual proportion of inflow diverted is 0.425. See Figure 9.</p>					

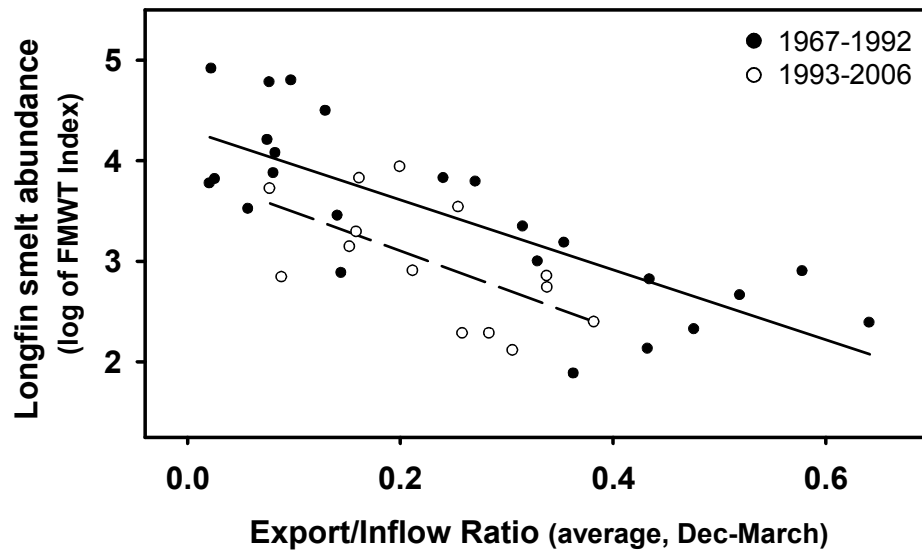
Units of measure and measurement periods for the preceding tables:

Flows are minimum monthly average flows. For all months, the 5-day running average of flow must be >80% of the required monthly level.

X2 values are maximum monthly averages.

Export/Inflow ratios (i.e., for total Delta inflow, San Joaquin River inflow, and for Sacramento River flow) are maximum 3-day running averages.

Figure 9: High E/I Ratios = Low Longfin Abundance



The abundance of longfin smelt (measured by the CDFG Fall Midwater Trawl Survey) is inversely related to the Export/Inflow (E/I) ratio measured earlier in the year during the winter (Dec-March): when the wintertime E/I ratio is high, abundance of longfin smelt is lower than in years when the winter E/I is low. Data Sources: California Department of Water Resources, Dayflow, and California Department of Fish and Game, Fall Midwater Trawl Survey.

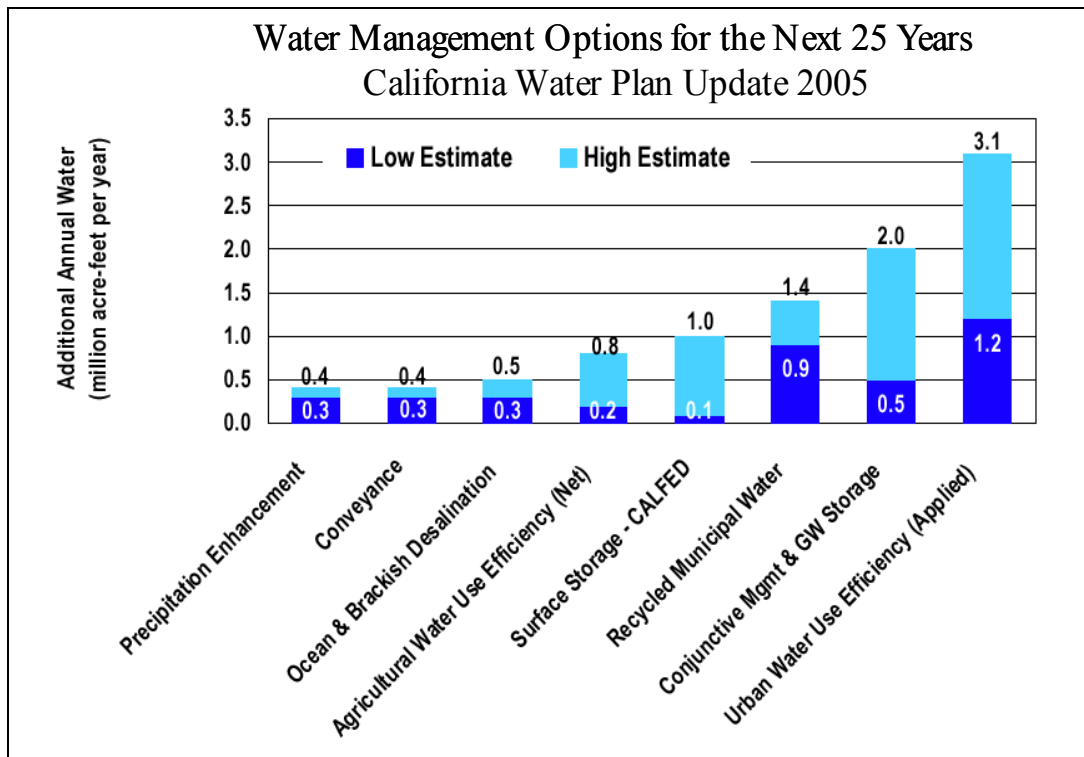
A LONG-TERM VISION FOR THE DELTA

Attachment 3: Potential Actions to Reduce Reliance on Delta Exports

The following measures to reduce the reliance on Delta exports can be implemented throughout areas that directly receive Delta water, as well in areas that do not use Delta water but are connected to Delta users – such as in the San Joaquin Valley – through artificial and natural conveyance. It may be necessary to provide additional regulatory mechanisms and incentives to facilitate the transfer and exchange of water from outside of Delta-dependent areas to Delta users.

The California Water Plan

The California Water Plan Update (2005) includes conservative and aggressive estimates of the water supply potential of a wide range of water management tools. This analysis, which was supported broadly by a stakeholder community that was deeply involved in the creation of the plan, demonstrates that efficiency, wastewater recycling and improved groundwater management, are not only environmentally preferable, but also represent the largest potential sources of “new” water to meet future needs in California. The plan also concludes that these alternatives are highly cost-effective. The water supply components of any long-term vision for the Delta should focus on these tools that are the most cost-effective and environmentally preferable, and which have the greatest potential to generate water supply benefits (See graphic below).



California Department of Water Resources, *California State Water Plan* (Bulletin 160-05).
<http://www.waterplan.water.ca.gov/cwpu2005/index.cfm>

Urban Water Efficiency

California's cities and suburbs use over 8 million acre-feet of water per year (MAFY), according to DWR. Much of that water is either diverted directly from watersheds that flow into the Delta or is pumped out of the Delta itself. Although California's population is expected to increase, perhaps to as many as 60 million people from its current 37 million by 2050, urban water use efficiency (WUE) efforts have the potential to keep urban water demand in check. For example, although the population served by the Los Angeles Department of Water and Power has increased by one million people over the past twenty-five years, water demand remained virtually unchanged.¹

Potential Water Savings: Improved urban WUE has the potential to save between 1.2 and 3.1 MAFY by 2030. Much of this potential could be achieved for a relatively low cost of \$230 - \$522 per acre-foot.² A Pacific Institute study indicates that 2.3 MAFY could be saved through the use of existing technologies and that at least 85 % of this savings (more than 2 MAFY) could be achieved at costs below that which it would cost to develop new sources of supply.³

Potential Energy Savings: In addition to huge potential water savings, urban WUE improvements can produce parallel energy savings and reductions in greenhouse gas emissions. For example, pumping one acre-foot of water via the State Water Project to Southern California requires 3,000 kWh. The California Energy Commission has estimated that 19% of the state's electricity demand, over 30% of the state's natural gas demand, and 88 million gallons of diesel consumption are associated with water use. A 2004 study by the Natural Resources Defense Council and the Pacific Institute concludes that if the City of San Diego relied on conservation instead of importing additional water from the Delta to provide its next 100,000 AFY of water, enough energy would be saved to provide electricity to 25 percent of the city's residents.⁴

While some regions of the State are making great progress in the area of conservation, others are far behind. The major urban water agencies in California agreed, as an outgrowth of the State Water Board hearings in 1992, to implement water conservation BMPs as a means to forestall more stringent requirements that the State Board was considering. A CALFED Comprehensive Evaluation of water use efficiency efforts in California found that this voluntary process is not working as intended and its impact on urban water use remains well below its full potential. Fifteen years later, it is time to assure that urban water agencies will live up those commitments: an urban certification program, which has been under development for almost 10 years, is long overdue. At a

¹ City of Los Angeles Department of Water and Power, *Urban Water Management Plan Fiscal Year 2003-2004 Annual Update*.

² Department of Water Resources, *California Water Plan Update 2005*, Bulletin 160-05, Vol. 2, Ch. 22, p. 4-5.

³ Pacific Institute, *Waste Not, Want Not: The Potential for Urban Water Conservation in California*, p. 1 (2003).

⁴ Natural Resources Defense Council & the Pacific Institute, *Energy Down the Drain: The Hidden Costs of California's Water Supply* (2004).

minimum, meeting these conservation commitments should be a prerequisite for receiving state grants or loans.

- Up to 60 percent of urban water use is dedicated to landscaping. As much of the new urban development is occurring in the hotter Central Valley and inland areas of Southern California and the San Francisco Bay area, it is imperative that the installation of regionally appropriate, low-water use landscapes be promoted much more aggressively. For instance, all new developments should be required to install water-efficient landscapes.

Agricultural Water Use Efficiency

Improved agricultural WUE has the potential to reduce overall demand for water from the Delta. Over the past few decades, California growers and agricultural water suppliers have made great strides through improvements to water delivery and on-farm irrigation systems. The use of these new technologies and management techniques could save even more water if implemented on a wider scale.

Potential Savings: It is conservatively estimated that further agricultural WUE improvements could save an additional 620,000 AFY statewide, with an investment per acre-foot of only \$242.⁵

Implementation Recommendations: The CALFED ROD called for an investment of \$1.5 - \$2.0 billion from 2000-2007 in agricultural WUE. Actual investment has fallen short of that mark. For some water suppliers and users, funding for efficiency improvements comes from water transfers. However, when conserved water is transferred to urban users, little or no instream benefits are realized, and energy use may actually increase. At the same time, some water suppliers and users hesitate to implement WUE measures because of fear that greater efficiency will jeopardize their continued rights to the water they have conserved. A more robust incentive structure must be implemented to encourage efficiency improvements to be returned to the environment. For example, the State could condition public funding for water supply projects on a commitment from grantees to return a portion of conserved water to the environment.

Improving water efficiency will also require better information about existing water use patterns. The CALFED expert panel on water measurement found that water resource management in California is handicapped by inadequate, incomplete and potentially inaccurate information about water use. Particularly in agriculture, the State doesn't know to any accurate degree how much water is being used and where. DWR should implement administrative actions identified by CALFED, including measuring crop water use consumption via remote sensing and better assessment of net groundwater usage.

⁵ Department of Water Resources, *California Water Plan Update 2005*, Bulletin 160-05, Vol. 2, Ch. 3, p. 7.

Water Recycling

As of 2005, California's Public Agencies recycled about 500,000 acre-feet of wastewater annually. Provided appropriate water quality and public health safeguards are in place, the use of recycled water can play an important role in reducing demand for exports from the Delta.

Potential Water Savings: Recycled water programs have the potential to produce over 1.5 MAFY by the year 2030. In 2005, the State Water Resources Control Board identified and prioritized 89 ready-to go recycled water projects that could be implemented almost immediately if funding were available. These projects alone have the potential to provide 400,000 acre feet of additional water. Costs estimates range from between \$300 and \$1,300 per acre-foot of recycled water, depending on the application and local conditions.

Implementation Recommendations: In 2003, the California Recycled Water Task Force issued a list of recommendations. Some progress has been made toward implementing these recommendations, but further work is needed to realize the potential benefits of recycled water. In sum, the Task Force called for:

- Increased funding for projects, research, and outreach.
- Improved technical assistance and planning tools.
- Conducting an independent scientific review of the viability of potable reuse.
- Demonstrating leadership support for water recycling.
- Improving regulatory mechanisms to clarify requirements for dual plumbed systems and identify gaps in existing State and local health regulations.

Groundwater Treatment/Desalination

Groundwater represents about 30-40 percent of water used in California. This percentage is even higher in dry years. Removing salts, including nitrates, can be a cost-effective means of producing clean water supplies, recharging stressed and contaminated aquifers, and increasing groundwater storage capacity without the need to build expensive surface storage projects. Although agriculture is by far the biggest consumer of groundwater, many urban and suburban areas in and around the Central Valley are totally dependent on groundwater, some of which is marginally usable because of its poor water quality. Southern California's groundwater basins are vital to its water supply and they can play a more significant role if contaminated areas can be cleaned up.

Potential Production: As of 2003, there were more than 40 brackish groundwater desalting facilities in California capable of generating 170,000 AFY. Within the next decade, an additional 30 to 35 facilities capable of generating nearly 290,000 AFY could

come on line, at a cost of \$130 - \$1250 per acre-foot, inclusive of all inputs and distribution costs.⁶ (In contrast, seawater and estuarine desalination is still expensive, energy intensive, and potentially environmentally damaging.⁷)

Implementation Recommendations: Invest in groundwater treatment in groundwater-dependent areas where alternative sources are limited. Provide technology and grants to the less wealthy, smaller communities of the Central Valley that rely on poor-quality groundwater. Insure that non-point runoff does not degrade groundwater resources.

Conjunctive Management and Reservoir Re-operation

Conjunctive management refers to the integrated use of surface water and groundwater resources. Conjunctive management projects would be most effective if located in areas where a variety of water sources could be used to increase groundwater storage, including conserved water, recycled water, and flood waters. One form of conjunctive management involves reservoir re-operation coupled with groundwater banking. In this case, surface water from selected reservoirs is pre-released for storage in groundwater basins during the summer and fall, increasing flood storage capacity in the participating reservoirs and creating the opportunity to augment the overall water supply by capturing additional wet-season runoff. The pre-released water stored in the groundwater basin(s) is not lost to the system, but will be available for water supply, ecosystem restoration, and mitigation of groundwater overdraft. While conjunctive management programs have the potential to provide multiple benefits, appropriate monitoring and analyses need to be performed to ensure accurate water accounting and protection of public trust resources.

Potential Production: Conservative estimates indicate that conjunctive management could increase annual water deliveries by 500,000 AFY, while more aggressive estimates suggest that the potential gains could be as high as 2 MAFY. Project costs range from \$10 to \$600 per acre-foot of increased deliveries, with an average cost of \$110 per acre-foot – well below the cost of additional surface storage investments.⁸

Urban Stormwater Management

Urban water agencies, particularly in Southern California, are increasingly recognizing the potential to provide multiple benefits by capturing, treating (where necessary), storing and using urban storm water. Such projects can provide water supply and flood management benefits, while reducing coastal pollution from urban runoff.

⁶ Department of Water Resources, Water Desalination: Findings and Recommendations, p.3 (2003).

⁷ Estuarine and seawater desalination currently use 3,260 to 4,900 kWh per acre-foot, which contributes to a total cost per acre-foot of \$700 to \$1,200, not including distribution costs of \$100 -\$300 per acre foot. *Id.* at p. 3-4. In addition to energy use, there are other potentially serious environmental problems related to seawater/estuarine desalination, including harm caused at intake facilities.

⁸ Department of Water Resources, *California Water Plan Update 2005*, Bulletin 160-05, Vol. 2, Ch. 4, p. 2-5.

Potential Production: Because accurate statewide estimates of potential costs and yield are difficult to locate, we cannot measure potential water supply benefits on a statewide basis. However, Los Angeles County recharges an average of 210,000 acre-feet of water per year.⁹

Implementation Recommendations: The state should conduct studies and develop pilot projects to quantify the potential costs and yield from improved storm water management.

Reclamation of Oil-field Produced Water

Oil extraction in the San Joaquin Valley and Southern California produces tremendous quantities of water that vary in quality from fresh to highly saline. Currently, about 40,000-50,000 AF per year of fresh produced water is being discharged to surface drainages under NPDES permits in Kern County. A similar amount of slightly brackish water is re-injected in oil fields throughout the San Joaquin Valley and coastal areas. Irrigation districts in Kern County use up to 25,000 AF of fresh produced water. It may be economically and environmentally feasible to reclaim the slightly brackish water, especially where oil producers currently lack disposal capacity or pay high costs – upwards of \$1000 per acre-foot—to dispose of it.

Implementation Recommendations: The state should conduct an engineering and economic analysis of the opportunities to reclaim and use oil-field produced water in the San Joaquin Valley and Southern California. Develop pilot projects that test the feasibility of producing and using the water.

Land Retirement

The Bureau of Reclamation's recent NEPA analysis of the western San Joaquin Valley's drainage problem identified the potential retirement of 200,000 to 300,000 acres of drainage-impaired land from irrigation as the most environmentally friendly and economically efficient alternative. Other sources suggest that a higher level of land retirement may be required to solve the drainage problem. In fact, implementation of a drainage solution involving extensive land retirement is necessary to comply with a court order. It will not be possible to farm much of the drainage-impaired land in the future if existing practices are continued. A well-designed land retirement program is not only preferable to simply waiting for this land to become un-farmable, but could also help reduce the West side region's reliance on Delta export supplies.

Implementation Recommendation: The federal government should implement a large scale land retirement program that provides cost-effective water quality benefits,

⁹ Department of Water Resources, *California Water Plan Update 2005*, Bulletin 160-05, Vol. 2, Ch. 21, p. 3.

significantly reduces existing Delta diversions, and mitigates impacts to West side communities. It is a sad irony that one of the most highly subsidized agricultural regions in the nation has failed to pass on those benefits to local communities.

An Effective Water Supply Response to Global Warming

Global warming will have a broad range of impacts on water resources in the Bay-Delta estuary and across the West. The discussion of these issues in the Delta Vision context has focused largely on sea level rise. However, global warming is also likely to lead to a reduction in water available from sources that rely on natural hydrology, including diversions such as those from the Bay-Delta system.¹⁰ There is significant evidence, but not yet a scientific consensus, that the Southwest will receive less precipitation in the future. This drying trend could affect parts of California as well. In addition, there is a scientific consensus that in the drier parts of the West, hotter future temperatures will increase evaporation across entire watersheds. Therefore, even if precipitation in the Bay-Delta watershed remains constant, as more water is lost to evaporation from snowpack, watersheds, rivers, lakes and reservoirs, we are likely to see a reduction in total stream flows in the future. DWR's technical analysis also reflects this prediction. Three of four DWR estimates of the effects of a changing climate on Delta inflows show a reduction in total inflows.¹¹

This prediction suggests that water users should prepare for this change by planning to reduce Delta diversions in the future. This conclusion reinforces recommendations to reduce Delta diversions on the basis of the current biological decline in the Delta, and on the basis of Delta levee stability risks. The best way for water users to reduce their vulnerability to global warming impacts related to the Delta is to increase investments in conservation, water recycling, integrated regional planning and other tools.¹² Fortunately, these tools are cost-effective today.

Implementation Recommendation: The Task Force should explicitly find that a reduction in net Delta diversions, and an increased investment in alternative water supplies, is likely to reduce the vulnerability of the state's water supply, and thus its economy, to the impacts of global warming.

¹⁰ Natural Resources Defense Council. *In Hot Water*. July 2007, p. 8
<http://www.nrdc.org/globalWarming/hotwater/contents.asp>

¹¹ California Department of Water Resources, *Progress on Incorporating Climate Change into Management of California's Water Resources*. July, 2006. Chapter 4.

¹²NRDC. *In Hot Water* contains extensive recommendations regarding how water managers can incorporate global warming issues into the management of their water systems.

A LONG-TERM VISION FOR THE DELTA

Attachment 4: Institutional Reform and a “Beneficiary Pays” Based Financing Plan

Institutional Reform

Recognize the Special Status of the Delta in Governance, and improve governance mechanisms for controlling urbanization, flood management, water operations and habitat restoration. Critical water management and land use decisions in the Delta cannot continue to be made by a patchwork of local governments, private interests, water projects and regulatory agencies in an uncoordinated and piecemeal fashion. A long-term Delta vision should include state and federal recognition of the Delta as an area of unique ecological, economic and cultural value, and establish new governance mechanisms to protect these unique values, potentially including the following:

- Protecting habitats and habitat corridors, floodplain corridors and other critical ecological areas in the Delta as state and federal reserves under the State and National Park systems and/or the state and federal wildlife refuge systems, potentially including designation of the entire Delta as a National Park or Reserve.
- Promoting legislative changes to existing land use regulations to prevent urbanization in the Delta primary and secondary zones, particularly in areas below sea level and in deep floodplains, including strengthening the Delta Protection Commission’s authority over the Delta secondary zone (or replacing it with a stronger entity) and reforming flood management decision making at the local level and at the California Reclamation Board to ensure adequate protection for Delta communities. Such reforms should include a prohibition on urban development on lands below sea level or in deep flood plains.
- Establishing clear and measurable performance targets for protecting the Delta’s ecological, economic and cultural values, such as reducing risk of extinction of native species to a trivial level; achieving a desired level of native species abundance and diversity in protected areas; setting an ecological safe yield for the Delta; and reducing exporter reliance on Delta sources by a set amount.
- Creating a new Delta Conservation and Development Commission (potentially as a successor to the current Delta Protection Commission) with enhanced authority to regulate land use, protect and restore aquatic habitat, and address water quality problems, on the pattern of the existing Bay Conservation and Development Commission. In addition to those representing Delta land users and local governments, the new Commission would include representatives from environmental, environmental justice, downstream and export interests with a stake in the future of the Delta. A new Delta conservancy could also be formed to assist with rapid efforts to acquire and manage habitat and promote other actions.

Reform the State Water Project and Improve Overall Water Operations Oversight: Even as Delta fish populations collapse and existing environmental protections are found to be inadequate, the State Water Project has been pumping record amounts of water in recent

years, including “surplus” water. Planned additions to the SWP, including use of increased export capacity and proposed new surface storage facilities, would significantly expand its ability to divert and export Delta flows. The SWP’s impact on the health of the Delta should be constrained and mitigated by the following potential actions:

- Eliminating the “off budget” status of the State Water Project and subjecting the SWP to normal state legislative oversight.
- Modifying SWP contracts to include appropriate shortage clauses, establish ecosystem enhancement as a project priority, and create incentives for reduced demand.
- Creating a new Delta Water Management Commission to provide oversight for both the State Water Project and the Central Valley Project and to better integrate the SWP and the CVP into a balanced long-term plan for the Delta. The Commission should be broadly composed, with representatives of the full range of those with a stake in the future of the Delta, including: SWP and CVP agricultural and urban contractors, Delta farmers, Delta communities, recreational and commercial fishing interests, communities downstream in the Bay that do not draw water from the Delta but are affected by upstream conditions, environmental justice representatives, and the environmental community. The Commission should have the authority to approve water project operations, ESA and water quality compliance and monitoring programs, and related project expenditures. The Commission should also set, collect and distribute the water fees proposed below.

Create a Private Enforcement Agreement: The Task Force should explore the potential for a private enforcement agreement between SWP and CVP contractors and a new governance entity to achieve desired Delta flow conditions and export reductions above the regulatory baseline. For instance, a new Delta Protection and Restoration Commission or Delta Water Management Commission could set performance targets for safe yield and export reduction. If the CVP or SWP fail to meet these targets, enforcement could be achieved through a contractual mechanism rather than solely on judicial enforcement. This agreement could provide, for example, two acre feet of water in compensation for each acre-foot of water diverted in variance from safe yield or export reduction targets. Compensation water should come with senior storage rights, and impacts of enforcement could be allocated among contractors either on the basis of current contractual allocations or through market mechanisms. Making this tool work would require the establishment and maintenance of a clearly established baseline. (Undermining the EWA baseline is one of the primary reasons for the failure of the Environmental Water Account.)

Require a Fair Share of Delta Flow from Upstream and In-Delta Users: As the largest diverters of water upstream of and in the Delta, it is appropriate that the CVP and SWP should bear the lion’s share of meeting regulatory requirements – as well as future performance targets – for securing a more natural flow regime and protecting beneficial uses of Delta waters. However, other non-state and non-federal water rights holders divert millions of acre-feet of water before it reaches the Delta or onto Delta islands. The

Task Force should recommend that the State Water Resources Control Board revise the permit conditions for non-project water rights holders to require that releases to meet Delta flow objectives be made more closely in proportion to each user's contribution to natural runoff.

A “Beneficiary Pays” Based Financing Plan

Develop a Financing Plan Based on the “Beneficiary Pays” Principle: The CALFED Program failed, in significant part, due to the lack of a financing plan and inflated expectations of available funding. The Delta Vision and Strategic Plan should include a clearly developed financing plan, based on a “beneficiary pays” principle. Because beneficiaries will be expected to contribute, the Delta Vision should be informed by and developed consistent with the ability of beneficiaries to pay for the anticipated benefits. An effective, comprehensive Delta plan will require many billions of dollars. This plan will fail if it relies solely on public and current private funding. The elimination of current “free riders” and the requirement that beneficiaries pay for future benefits is a necessary element of a successful Delta plan.

Eliminate Public Subsidies for Endangered Species Act Compliance: The CALFED Environmental Water Account pioneered an experimental approach that replaced ESA compliance with a publicly subsidized program to compensate for water supply impacts by exporting and storing replacement water supplies south of the Delta. This approach has proved to be a colossal failure, in which targets for securing EWA assets have not been met, those assets which have been secured are not aggressively used, and the constraints placed on new environmental protections have failed to prevent collapse of the Delta ecosystem while permitting record levels of export. The Task Force should recommend eliminating the EWA approach and replacing it with a combination of compliance with the minimum requirements of the law and the use of private enforcement agreements to achieve targets above those minimal levels.

Direct State Water Bond Funding to the Most Cost-effective Water Strategies, Target Projects that Decrease Delta Water Dependence, and Require Matching Funding: The Task Force should recommend that any state funding designed to assist in the reduction of Delta diversions, or providing additional water supply reliability benefits, be allocated to the most cost-efficient tools. Grants should be conditioned on a minimum 50% water user matching contribution and a demonstrable reduction in demand for water from the Delta.

Create a System of Export User Fees to Eliminate Current Free Riders: The Task Force should consider the creation of the following export user fees:

- A new SWP Restoration Fund, to parallel the existing CVPIA Restoration Fund.
- An export fee to obtain contributions from CVP and SWP exporters to assist in the maintenance of Delta levees.

- An export user fee, similar to the PUC's public benefits charge. These funds would internalize some of the cost of Delta diversions and help water agencies finance the development of alternative water supply tools.

Some of these fees may be appropriate to extend to other water users as well. However, for example, in the case of levee maintenance, in-Delta water users already contribute to levee maintenance. Upstream water users, on the other hand, receive no benefit from these Delta levees but should contribute to funding restoration programs that help mitigate their impacts on Delta flow conditions.